AMERICAN ENGINEER CAR BUILDER AND RAILROAD JOURNAL.

NOVEMBER, 1898.

CONTENTS.

THE CONSTRUCTION OF A MODERN LOCOMOTIVE.*

By T. R. Browne,
Master Mechanic, Juniata Shops, P. R. R.

VI.

Erecting Shop.

To the reader of preceding articles in this series it is apparent that the description of operations performed in the various departments, taken collectively, indicate a steady progress toward the complete engine and a systematic delivery of all of the various parts required in its final erection in the erecting shop. Some idea of the immense amount of detail in the modern locomotive may be formed when we state that the average modern engine contains approximately 20,000 separate and distinct pieces, and of this total number 13,600 pieces, approximately, are handled, fitted and formed into parts for use in the erecting shop by the various other departments throughout the plant, and the balance, or 6,400 pieces, are handled in the process of actual erection in the erecting shop. We have previously, and wish to again emphasize, the importance of considering the erecting shop only as a place where actual erecting is done, that is to say, it is not equipped with machinery except that required for the lifting and handling of the various parts and the equipment necessary in the operations of erecting, and no machine work of any kind is performed in this department except the drilling of certain holes which can only be done in erecting and the reaming incident to the use of taper bolts. The concentration of the manufacture of all of the parts of the locomotive in other departments than the erecting shop, and the consequent necessity that these parts when delivered shall be accurate in every respect, places the erecting department in the position of general inspector of the output furnished from other departments to it, and under the supervision of a careful and intelligent foreman the advantages of this will be obvious. Following the schedule referred to in previous articles indicating the order in which each part or group of parts will be required by the erecting shop, continuous and uninterrupted erection in this department is possible, and for better illustration of the various stages leading to completion of a modern locomotive the accompanying photographs selected for the purpose of illustrating an average case and taken at intervals of ten hours will graphically illustrate the various stages of erection.

Figures 1 and 2 indicate respectively the boiler schedule "A" and the frames schedule "B," with the various parts ready to be fitted to them. These are all of the parts required in this particular stage of the operation or on this schedule. The placing or erecting of the parts shown in Figs. 1 and 2 is performed by separate gangs of men, and these two operations are carried on simultaneously. Figs. 3, 4 and 5 illustrate the condition of erection at a period 10 hours later than the condition illustrated in Figs. 1 and 2, and during which time the parts shown in Figs. 1 and 2 have been attached and connected, the frames placed on the pit and the boiler lowered on the frames as shown in Fig. 6, in which condition the further erection included in schedule "E" is commenced. It will be recalled that the schedule sheet for ordering and turning out the various parts is divided into six grand divisions and designated by the letters "A," "B," "C," "D," "E" and "F," in which schedule "A" includes the boiler with all of the necessary attachments and parts as shown in Fig. 1; schedule "B" the frames with their various parts and attachments as shown in Fig. 2; letter "C" the wheel and engine truck work, complete parts for which are furnished by the machine shop; letter "D" tank and tender work; letter "E" the general erection and completion, the beginning of which is illustrated in Fig. 5, and letter "F" final test and inspection. Fig. 7 illustrates the condition of erection at a period of 20 hours later than that illustrated by Figs. 1 and 2, and 10 hours later than its condition illustrated in Fig. 5, during which time all of the various valves and attachments, including steam pipes, etc., necessary for the preparation of the boiler for test have been put on and connected, and the boiler given a water and steam test.

Figs. 7 and 8 illustrate two views of the erection during this period, and in which the boiler is shown in the process of receiving a steam test. It will be noticed in Fig. 8 that the steam is blowing off, the maximum pressure required having been reached. This testing is done with fuel oil, which is burned by means of a burner attached to an ordinary fire door provided with a special gas generating nozzle illustrated in Figs. 9 and 10, compressed air being used for atomizing the oil and creating the necessary amount of pressure for feeding the oil to the burner. The oil tank is mounted on a pair of wheels for convenience of moving to various parts of the shop where testing may be necessary, and the connections, both for air and oil, from this tank to the burner are made with ordinary air hose. In making the test in this way the boiler, after being filled to the proper water line, is charged with steam from the stationary plant to a pressure of from 50 to 60 pounds, and the oil burner is then started and the test completed in about three-quarters of an hour. The flame from the oil burner, owing to the peculiar construction of the burner, is practically a gas flame, and no free oil is discharged into the fire box; the flame of gas formed by the burner burning in the form of a large brush on the inside of the fire box. It has not been found necessary to make any provision for fire brick or insertion of any special appliance on the inside of the fire box for this operation.

All of the air pumps, before being placed in service, are carefully tested under steam, and the output from these pumps, while being tested, has been found sufficient to not only furnish the required amount of compressed air for operating the burners for testing boilers, but also the large number of pneumatic hammers, drilling and reaming machines used throughout the shop in the various operations of erecting. A convenient form of mounting four of these air pumps for test is so arranged that they can be removed from time to time at the completion of test and others put in their places without disturbing an unnecessary amount of piping.

*For previous article see page 329.

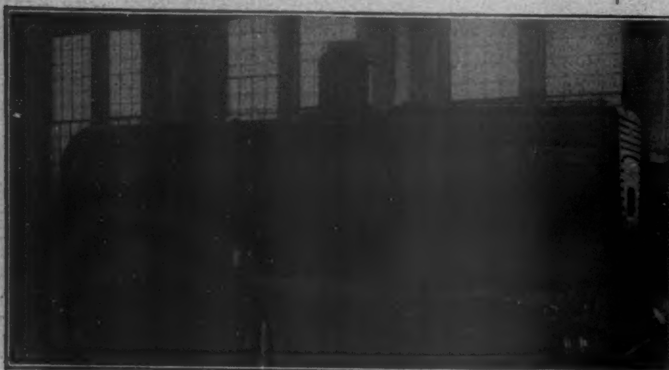


Fig. 1.

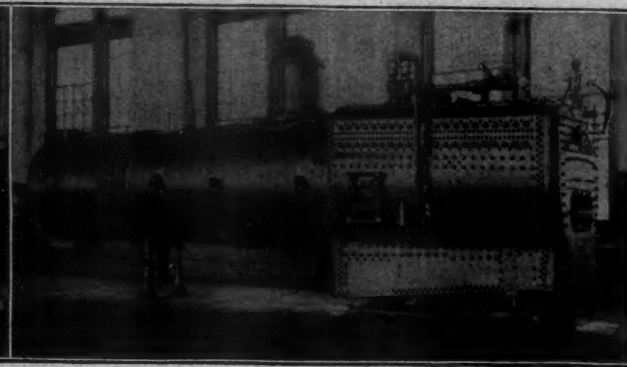


Fig. 4.

Fig. 2.

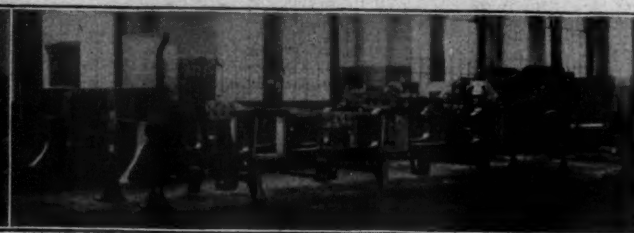


Fig. 3.

Fig. 5.

Fig. 6.

Fig. 7.

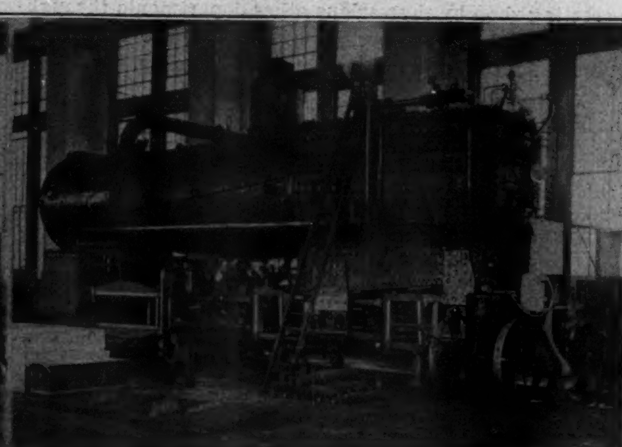


Fig. 8.

CONSTRUCTION OF A MODERN LOCOMOTIVE—THE ERECTING SHOP.

By T. R. Browne.

Fig. 11. Fig. 9. Fig. 10.

Fig. 12.

Fig. 13.

Fig. 14.

CONSTRUCTION OF A MODERN LOCOMOTIVE—THE ERECTING SHOP.

BY T. R. BROWNE.

They are placed in the four corners of a square, which renders the piping very convenient and compact. In cold weather it has been found convenient to use the exhaust from these air pumps for heating the shop.

Considered from the standpoint of safety and uncertainty as to maintenance of proper alignment, the use of wooden blocking necessary and usually used in the operations of erecting shown in Figs. 2 and 5, has made advisable the adoption of a device similar to that illustrated in Fig. 11, which is provided with two adjustments for vertical and side alignment, and arranged to be either used on the pit or on the floor.

Fig. 12 illustrates the condition of erection on schedule "E" 30 hours later than the condition illustrated in Figs. 1 and 2, and 10 hours later than the condition illustrated in Figs. 6, 7 and 8, during which time two additional steam tests have been applied, the lagging put on and jacket partially completed, together with other work, as will be clearly noted in the illustration. Fig. 13 illustrates the condition of erection 40 hours later than that illustrated in Figs. 1 and 2, and 10 hours later than the condition shown in Fig. No. 12; during this period all of the final parts have been put in place, valve cut-offs checked up and the engine prepared for the paint shop. Fig. 14 illustrates the complete engine at a period 50 hours later than the conditions illustrated in Figs. 1 and 2, and 10 hours later than the condition illustrated in Fig. 13. During this period of time it has received the final finish in the paint shop and been delivered to the erecting shop, with the rods connected up and the tank, as per schedule "D," provided and

Fig. 15.

Locomotive and Boiler Register.

Class .... No............Type ....Construction No..........Order........
Shop orders ....Commenced...... ..... Finished............Tested... ....
Water pres .... lbs. Steam pres ....lbs. Safety valves set at ....
Left shops............Boiler built from standard print No ....
Engine built in accordance with general plan. ....

Boiler.	Remarks.	Engine.	Remarks.	Tender.	Remarks.
Barrel A^1		Injectors		Water capacity	
" A^2		Steam Guages		Coal capacity.	
" A^3		Safety valves.		Steel	
Smoke box B		Lubricators		Tank valves	
Roof D		Air pump regulator		Tool boxes	
Side E		Tires		Rivets	
Back head F		Driving springs		Frame	
Throat G		Truck springs		Trucks	
Neck Q		Lagging		Steam heat	
Front tube H		Jacket		Air brake	
Dome K		Driver brakes.		Water scoop	
Firebox sides M		Driving axles		Coupler	
Crown N		Truck axles		Height top of rail.	
Door O		Driving wheels		To underside of frame	
Tube P		Truck wheels.		Wheels	
Smoke box extension R		Running boards		Axles	
Dome flange U		Pilot			
Butt strips		Stack			
Dome top and ring		Height of stack			
Flues		Sanding device			
Ferrules		Steam heat			
Rivets		Coupler		Painting.	
Grates		Cab			
Mud ring		Exhaust column			
Mud plugs		Exhaust nozzle			
Washouts		Kind of fuel		Primer	
Boiler checks		Crank pins		Filler	
Stay bolts		Cylinders		Varnish	

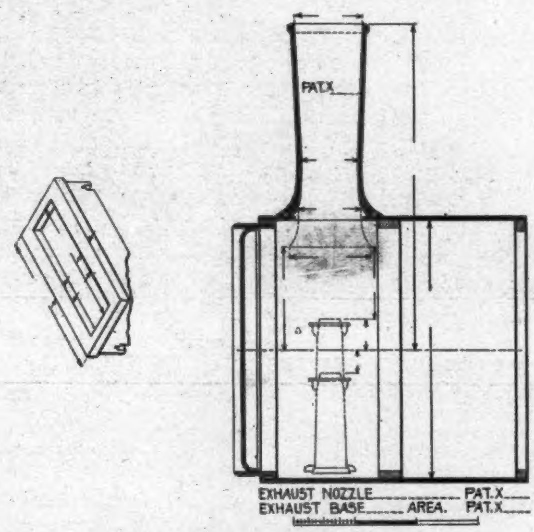
Valve motion of class........Engine
Engine No...... Construction No....
Out of Shops......189....
Cylinders.... x ....Throw of Eccentric.....
Steam Ports ... x ....Travel of Valve. ...
Exhaust Port... x ...Bridle Pin, Back.....
Bridges ....Lead, Full Gear.....
Outside Lap....... ....Valves set by........
Inside Clearance...... ....

	Reverse lever notch.	Cut off front end right.	Cut off back end right.	Cut off front end left.	Cut off back end left.	Difference in cut off.	Lead, front.	Lead, back.	Maximum port opening.
Forward Motion.									
Back Motion.									

Remarks ....
.... Supt.

connected, oiled, finally inspected, tested as per schedule "F," given a preliminary trial and is ready for trial in actual service.

In an earlier article we indirectly emphasized the importance in connection with the testing and inspection of material, of complete records of parts and material used in the various engines constructed. Fig. 15 illustrates one page of the book of engine records and on which is entered such information as is indicated by the various headings and which constitutes a valuable record of that character. It will be noted that provision is made for not only reporting the kind and character of material used, but the valve settings, cut-offs, etc., and also the general front end arrangement, which can be sketched in on the diagram of the smoke box provided. This diagram is provided with cross-section lines for ease in sketching. They do not appear in the engraving. Fig. 16 illustrates a form used by the erecting shop for reporting the cut-offs, etc., on each engine turned out and from which entries are made on the engine record.

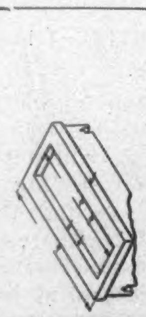


Diagrams Accompanying Fig. 15.

Fig. 16.

Valve Motion of Class..............................Engine.
Engine No........... Construction No...........
Out of Shops....................189....
Cylinders .... x ....Throw of Eccentric.................
Steam Ports......... x.............Travel of Valve....................
Exhaust Ports ....x..............Bridle Pin, Back....................
Bridges.................................Lead, Full Gear.......................
Outside Lap............................Valves Set by
Inside Clearance.......... .. ..

	Reverse Lever Notch.	Cut-off Front End Right.	Cut-off Back End Right.	Cut-off Front End Left.	Cut-off Back End Left.	Difference in Cut-off.	Lead, Front.	Lead, Back.	Maximum Port Opening.
Forward Motion.									
Back Motion.									



Inverted Plan of Valve.

Remarks..
....,
Supt.

Paint Shop.

The systematic following up of the work in the erecting shop by the foreman of the paint shop avoids the necessity of a very large installation in the way of buildings for the painting of locomotives for the reason that a very large amount of the preliminary painting can be done on the various parts during the process of erection, leaving only the final finishing and last coat of varnish necessary, and this should be more properly done in a building free from dust and which can be kept up to the temperature required for proper and quick drying. An inspection of several of the illustrations of process of erection will clearly indicate the results of this system. The paint shop should contain the necessary amount of room proportionate to the output and allowance made for engines to remain in it for final finish, a period not exceeding 12 hours for each engine. The amount of time for tank storage during the process of painting should also be arranged for on the same basis, making allowance for the fact that a great deal of the priming and much of the filling of tanks can be done in the shop in which these tanks are built prior to their final sending

to the paint shop. The painting and complete finishing of cabs, except the final coat of varnish, is done in this department, and they are only delivered to the erecting shop when the engine is ready to receive them.

Testing.

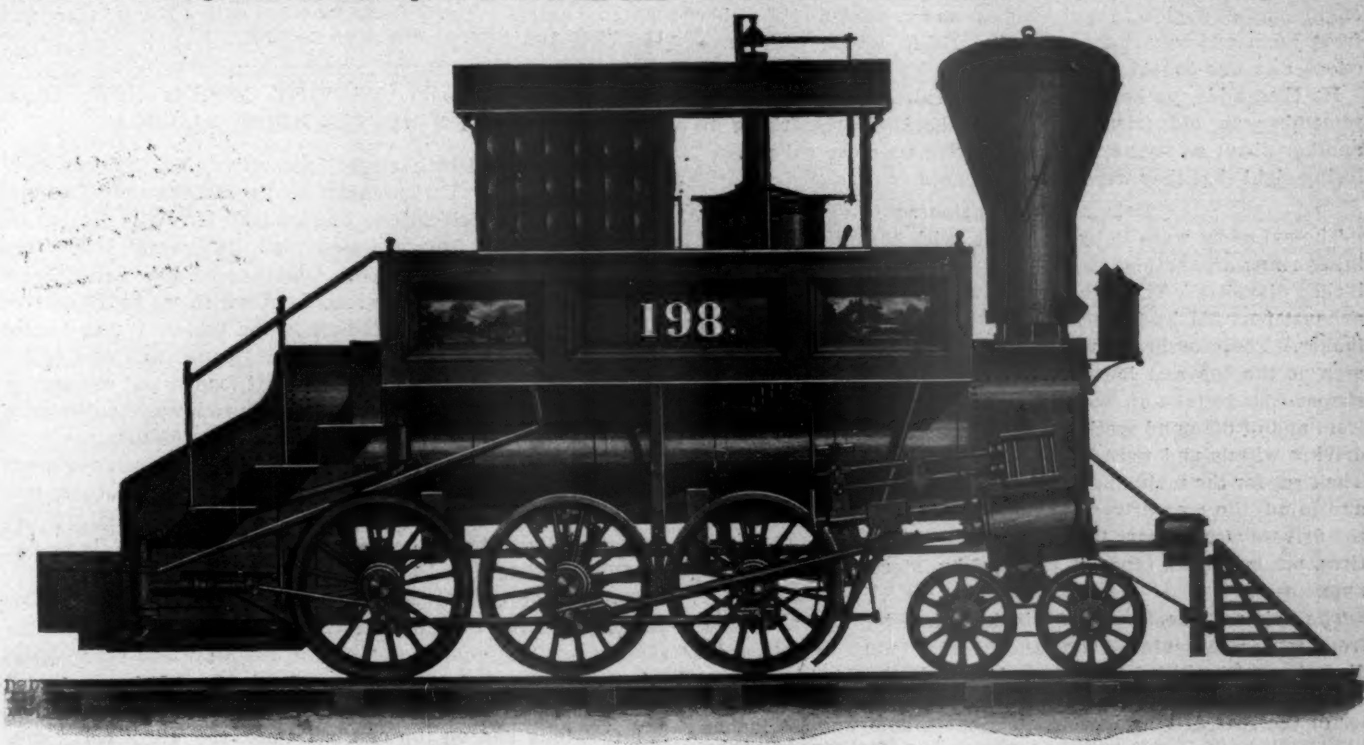
To a very large extent the careful inspection and testing which this engine has received up to the point illustrated in Fig. 14 can be properly included as a test of the engine as far as its mechanical perfection is concerned, considered from a standpoint of workmanship. The test as to efficiency and general economy can only be made in actual service or by placing the engine on a specially equipped testing plant provided for the purpose. For very many reasons we consider the latter method the most satisfactory, permitting the test to be conducted under the direct supervision of the constructors of the engine and at the shops in which it has been built, securing all of the incidental and valuable data in the form of records at that particular plant. The advantages of records of this kind in securing new business and meeting requirements of customers for locomotives will be obvious. Testing plants of this kind are not sufficiently common to warrant the advocacy of an arbitrary design, and while those that we know of have been very successful, we believe that future installations for this purpose will contain improvements and simplifications which these do not possess. It is, of course, understood that a plant of this kind can only determine the relative fuel economy, tractive force and general efficiency (as far as that character of information goes) of the machine as a hauling device, and that the imperfections of mechanical design, which would create an excessive cost for repairs, can only be determined by actual service, and we therefore think that for all practical purposes, including fuel consumption and hauling capacity, the test in actual service will sufficiently determine the relative economies of different types of engines.

The near approach to completeness in the use of interlocking and air-brake apparatus in Great Britain should be an example to us. Ninety-nine per cent. of the switch and signal levers on the railroads of the United Kingdom are interlocked and continuous brakes are in use on 95 per cent. of the locomotives and cars.

HAYES' TEN-WHEEL LOCOMOTIVE.

By M. N. Forney.

The illustration herewith is a copy of an old lithograph of what was known as the Hayes ten-wheeler, built for the Baltimore & Ohio Railroad, away back in the fifties. At that time that company had just opened its line west of Cumberland, and the trains had to surmount the continuous grade of 116 ft. to the mile for 17 miles, beginning at Piedmont. Passenger engines were taken up this grade with one of Winans' "camel" engines behind as a pusher. Mr. Samuel J. Hayes was then Master of Machinery, as the Superintendent of that department was called, and he conceived the idea of a passenger engine designed somewhat on the lines of the Winans camel engines. He adopted Winans' plan of boiler, with the sloping fire-box behind, and the cab on top, but he provided a leading truck in front which it was thought would make the engine curve better.



Hayes' Ten-Wheel Locomotive.

At that time Mr. Hayes had just been appointed to the position in charge of the machinery on the line, and his purpose was to produce an engine resembling the camel, but adapted to passenger service. Mr. David Rennie was Mr. Hayes' assistant, John Cochran was Mechanical Engineer and Mr. W. S. G. Baker, now President of the Baltimore Car Wheel Works, was his assistant. The lithograph was a copy of a drawing made by Mr. Baker, who writes that "The general designs were put in shape by Cochran, Mr. Hayes gave it careful attention as work progressed. There was much adverse criticism—Mr. Winans being among the critics. Zerah Colburn was a frequent visitor to the Mount Clare shops of the B. & O. road during those days, and he was a favorable critic. He was greatly interested in all matters pertaining to railroad progress, particularly in the mechanical appliances.

"The valve-gear received very serious attention and also the scheme of Cochran's of carrying the shaft which operated the withdrawal of the cut-off valve stem through the boiler. The cut-off rocker was loose on the shaft of the main-valve rocker and was in constant action when the engine moved.

"My general impression at the time was that Mr. Hayes conceived the general plan, which was worked up by Cochran with many comments by Mr. Rennie."

These engines were among the first, if not the first, ten

wheeled passenger engines used, but their use was not confined to passenger service, as they were found to be so efficient that they were also extensively adopted for freight service. After Mr. Hayes left the road a number of different forms of freight engines were built and bought by this company. During the war an increase of motive power was urgently needed, and had to be obtained as quickly as possible, and the question was which of the many kinds then in use would be the most serviceable. Mr. Davis was then the Superintendent of Motive Power, and he and the older Mr. Garrett—then President—decided to have more of Hayes' ten-wheelers built, and the decision was carried out, with the modification that a link motion was substituted for the valve-gearing originally used.

For the following particulars and dimensions of these engines we are indebted to Mr. Baker, who in sending them, says: "I remember the very great interest I took in the success of the engine and how pleased and happy I was to take a ride in her from Piedmont to Altamont, up the 116-ft. grade, with three cars. She was considered a marvel."

He then adds, pathetically: "We are all old coveys now; I remember an old friend who was about 80, remarking to another about as young, 'that there were no more old people,' losing sight that they were both grown old."

Data and Dimensions.

The cylinders were 19 by 20 inches, with spring packing and brass rings on the pistons, the piston rods being of iron, 2¾ inches diameter. The steam ports were 1½ by 14 inches, the exhaust port 2½ by 14 inches, and the travel of the valve 4½ inches. The crossheads were made of brass, with gun metal gibs at the top and bottom, arranged with bolts and wedge shaped tops to take up wear. The guide rods were of wrought iron, and of diamond section. The main rods led to the center driving wheels and were 7 feet 7 inches from center to center. The tires for the main and leading drivers were 6½ inches wide and blind, the rear drivers having flanges. The centers of all the drivers were of cast iron, fitted with chilled faced cast iron tires, put on with a taper fit and held by lateral hook keys and nuts.

The driving wheels were 50 inches diameter and 52 inches from center to center. The truck wheels were 28 inches in diameter, with chilled faces placed 36 inches, center to center, and the center of the truck was 15 feet 8 inches from the center of the rear driving wheels. The main axle was 5½ inches in diameter, the others being 5 inches. The total weight of the engine was 60,000 pounds, about 48,000 pounds being on the drivers.

The truck bolster was of wrought iron, with its center forged on, the journals formed at the ends and fitted into housings resting upon and keyed to semi-elliptic springs, 36 inches long, the ends of which rested and slid within seats formed on top of the truck frames. The frames were of wrought iron, with the pedestal jaws forged on. The jaws were slotted to shape and fitted with cast iron shoes and wedges adjustable from below. The axle boxes were of gun metal and the springs were semi-elliptic, graduated. They were equalized upon the main boxes and were connected to the boxes by pins passing through the frames upon which the springs rested. The frames were rigidly secured to the smoke box, but were free at the firebox end and so arranged that the boiler was free to slide upon them and was held in place by sleeves passing around the frames and bolted to the firebox.

The boiler was horizontal and straight. It was 48 inches in diameter, with single riveted seams, and was made of 5-16-inch iron. The dome was 30 inches in diameter and 36 inches high, with a cast iron flange and top made with a ground joint. The safety valves were formed in the top and connected by a lever to a spring balance. The dome was placed 54 inches back of the front flue sheet. The firebox was of copper, with 5-16-inch sides and ⅝-inch flue sheet. It was 42 by 58 inches in size and there were 160 2¼-inch flues of lap welded iron 14 feet 4 inches long.

The feed water was supplied by two single acting pumps attached to the sides of the firebox and operated by cranks attached to the crank pins of the rear driving wheels. The feed water entered the boiler by checks immediately in front of the back flue sheet, and was then conveyed by a pipe inside the boiler and discharged immediately back of the front flue sheets. Rocking grates were used, operated by a lever on the footboard, with a drop grate in front. The drawbar was attached to the ash pan as in the Winans camel engines.

The valve gear was of the hook type, with cut-off worked at half stroke, and operated by a separate eccentric and rocker. The valve stem of the cut-off was so arranged that it could be thrown out of gear, the valve remaining stationary when the cut-off was not used.

Steam was taken from the top of the dome through a slide valve throttle, operated by a crank connected to a screw with large pitch. The gage cocks were in the waist of the boiler below the footboard of the cab and operated by long stems and levers. The pilot in front of the engine was so arranged that it could be folded back when not on the road. This was done to permit of closing the doors of the engine house when the engine was in the stall. The smoke stack was arranged for soft coal fuel. It was formed with a center pipe 12 inches in diameter, over which a cast iron deflector was placed. This was to deflect sparks into a hopper formed by a second pipe, with a space between it and the central one. This space was provided with an outlet at the bottom to facilitate the removal of accumulated sparks. The top was provided with a bonnet hinged to the stack and covered with iron netting.

NEW SCHENECTADY FREIGHT MOGUL—NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

A new 20 by 28-inch mogul locomotive, No. 786, has been built for the New York Central by the Schenectady Locomotive Works to specifications prepared by Mr. Wm. Buchanan, Superintendent of Motive Power, and its general appearance is shown in the photograph. This engine has pulled some very remarkable trains, the records of which we have received from the builders and reproduce in the table. It has hauled a train of 3,428 tons, composed of 81 loaded and one empty car, and on another trip 3,063 tons in 81 loaded and one empty. The freight was grain. The heaviest train was hauled on a consumption of only 4.5 pounds of coal per 100 tons per mile, which is remarkably low. In the opposite direction a train of one loaded car and 126 empties, weighing 1,834 tons, was moved with a consumption of but 7.7 pounds of coal per 100 tons per mile. The runs were made between West Albany and De Witt, a distance of 140 miles.

The weight of the engine on driving wheels is 123,000 pounds, and the cylinders are 20 by 28 inches. The heating surface is 2,110 square feet and the grate area 30 square feet. The boiler is not large in diameter, but it has an extended wagon top and large heating surface for its size. The firebox is 9 feet long and on top of the frames, the width being 40⅜ inches. The crown sheet is supported by radial stays. Among the minor features are the large (9 by 12) driving journals, the extended piston-rods, which have made so good a name for themselves on this road, the very light pilot, and on the tender the suspension of the springs by links.

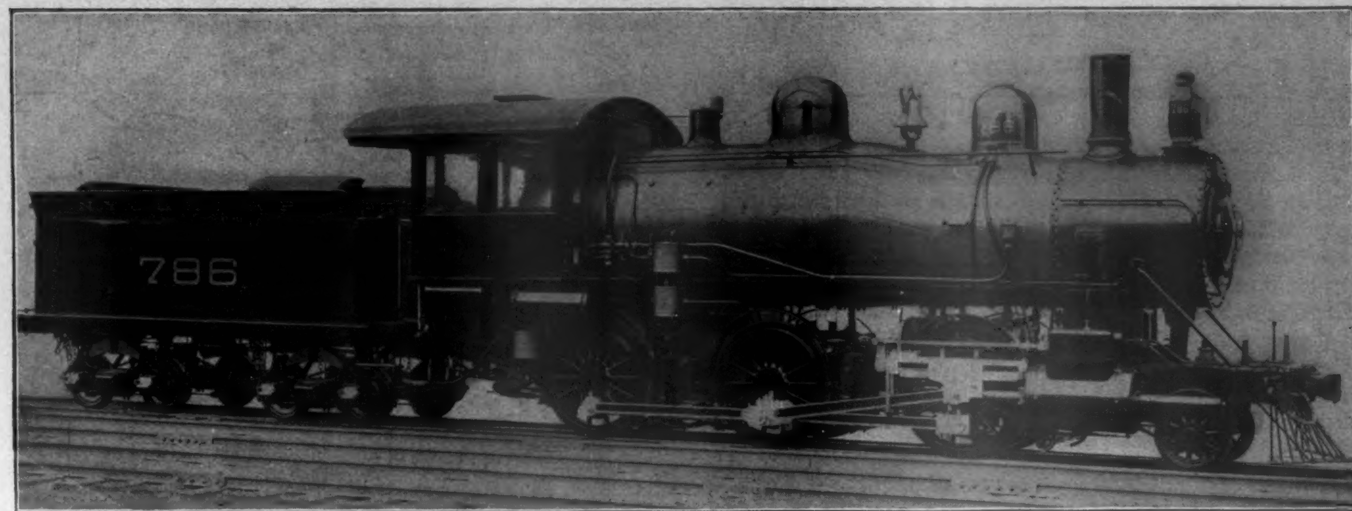
The information concerning the performance of this engine is incomplete without a statement of the grades, and we expect to show the profile of the road between West Albany and De Witt and some interesting indicator cards in a future issue. Until then we can only say that the grade line is undulating, and some of the curves are sharp. The new engine was designed to increase the average train loads on this division by 25 per cent. over those hauled by 19 x 26-inch mogul engines now used, and the heavy trains hauled in these tests are about 40 per cent. above the ordinary work done by the old engines. The new engine is able to haul 2,400 tons of paying load on this division, which is much better than the best work of the older design.

Records of six trial trips and general information pertaining to the engine are given as follows:

(It should be noted that the relatively high fuel consumption for the trip of September 28 was due largely to a 50-mile head wind.)

General Dimensions.

Gauge	4 feet 8½ inches
Fuel	Bituminous coal
Weight in working order	142,200 pounds
" on drivers	123,000 pounds
Wheel base, driving	15 feet 2 inches
" " rigid	15 feet 2 inches
" " total	23 feet 3 inches



Schenectady Mogul Freight Locomotive—New York Central & Hudson River R. R.

Cylinders.

Diameter of cylinders....20 inches
Stroke of piston....28 inches
Horizontal thickness of piston....4½ inches and 5 inches
Diameter of piston rod....3⅜ inches
Kind " " packing....Cast iron
Size of steam ports....18 inches by 1¼ inches
" " exhaust " ....18 inches by 2¾ inches
" " bridges....1⅛ inch

Valves.

Kind of slide valves....American balanced
Greatest travel of slide valves....5½ inches
Outside lap " " " ....⅞ inch
Inside " " " " ....3½ inches
Lead of valves in full gear......0 inch, 1-16 inch lap front and back

Wheels, Etc.

Diameter of driving wheels outside of tire....57 inches
Material " " " centers,
Main cast steel F. & B. steeled cast iron
Tire held by....Shrinkage
Driving box material....Gun iron
Diameter and length of driving journals,
9 inches diameter by 12 inches
" " " " main crank pin journals,
(Main side. 6¾ inches diameter by 5¼ inches)
6 inches diameter by 6 inches
" " " " side rod
Front, 5 inches diameter by 3⅝ inches
Back, 5 inches diameter by 3¾ inches
Engine truck, kind....2 wheel, swing bolster
" " journals....6¼ inches diameter by 10 inches
Diameter of engine truck wheels....30 inches
Kind " " " "
Krupp steel tired cast iron spoke center

Boiler.

Style....Extended wagon top
Outside diameter of first ring....62 inches
Working pressure....180 pounds
Material of barrel and outside ~~of firebox~~....Carbon steel
Thickness of plates in barrel and outside of firebox,
11-16 inch, ⅝ inch, 9-16 inch, ½ inch and 7-16 inch
Firebox, length....108 inches
" width....40⅝ inches
Firebox, depth....Front, 78½ inches; back 66½ inches
" material....Carbon steel
" plates, thickness....Sides, 5-16 inch; back, 5-16 inch; crown, ⅜ inch; tube sheet, ½ inch
" water space,
Front, 4 inches; sides, 3½ inches; back, 3½ inches
" crown staying....Radial stays, 1 inch diameter
" stay bolts....1 inch diameter
Tubes, material....Charcoal iron
" number of....310
" diameter....2 inches
" length over tube sheets....12 feet 0 inches
Heating surface, tubes....1,934.24 square feet
" " water tubes.... — square feet
" " firebox....176.6 square feet
" " total....2,110.84 square feet
Grate " ....30.3 square feet
" style ....Rocking
Ash pan " ....Sectional with dampers front and back
Exhaust pipes....Double, high
" nozzles....3¼ inches, 3½ inches and 3¾ inches diameter
Smoke stack, inside diameter....16½ inches
" " top above rail....14 feet 3 inches
Boiler supplied by.......Two Nathan & Co. Monitor No. 10 injectors

Tender.

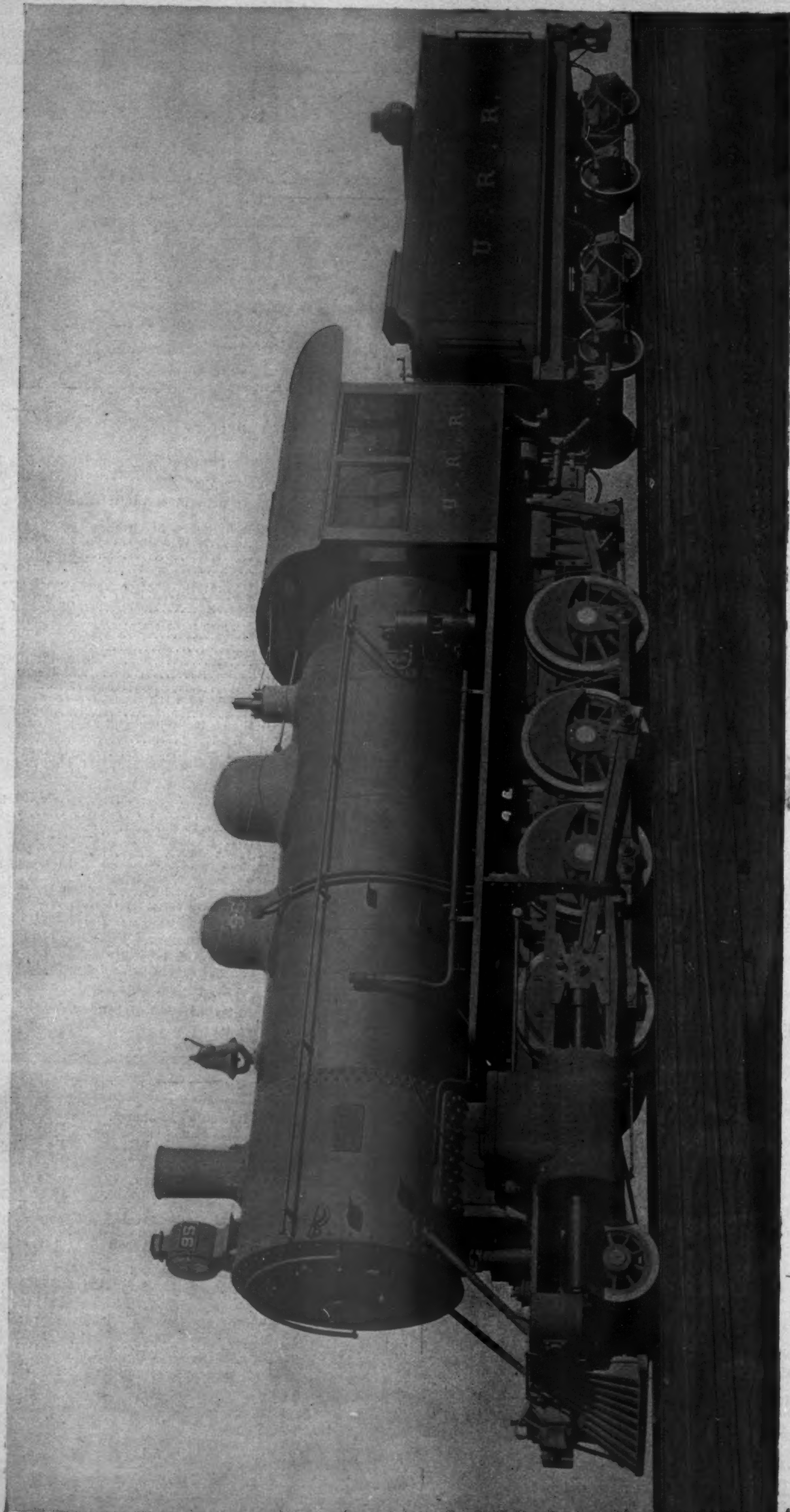
Weight, empty....28,700 pounds
Wheels, number of....8
" diameter....30 inches
Journals, " and length......4½ inches in diameter by 8 inches
Wheel base....15 feet 10½ inches
Tender frame....6½ inches by 4 inches by ⅜ inch angle iron
" trucks....4 wheel, wood bolster, side bearing, N. Y. C. style
Water capacity....4,500 U. S. gallons
Coal " ....10 tons
Total wheel base of engine and tender....50 feet 4⅞ inches

Special Equipment.

American brake on all drivers, operated by air.
Westinghouse automatic air brake on tender and for train. 9½-inch air pump.
2 3-inch muffled safety valves.
Gould coupler at front of engine and rear of tender.
1 16-inch round case headlight.

Record of Six Trips Between West Albany, and De Witt.

Date.	September 28.	September 29.	September 30.	October 1.	October 3.	October 4.
Terminal points	W.A. to D.W.	D.W. to W.A.	W.A. to D.W.	D.W. to W.A.	W.A. to D.W.	D.W. to W.A.
Weather	Windy	Fair	Fair	Fair	Fair	Fair & Showery
Condition of rail		Good	Good	Good	Good	Good & Slippery
Temperature atmosphere	....	....	58	67	70	72
Steam pressure	177	177.5	178.5	178.5	179	179.5
Elapsed time	10 hr. 12 min.	10 hr. 57 min.	10 hr. 24 min.	12 hr. 5 min.	11 hr. 31 min.	12 hr. 31 min.
Detentions, number of	5	6	5	8	6	6
Running time	9 hr. 10 min.	9 hr. 6 min.	8 hr. 55 min.	10 hr. 3 min.	9 hr. 49 min.	6 hr. 53 min.
Average speed, miles per hour	15.17	15.27	15.62	13.83	14.2	14.04
Number cars in train	91 lt. 1 load	2 lt. 71 load	112 lt. 1 load	1 lt. 81 load	126 lt. 1 load	1 lt. 85 load
Loaded weight train, tons	1,441	2,838	1639	3063	1834	3250
Number tons hauled 1 mile	200,299	394.482	227,821	425.757	254,926	451.750
Gallons water used, actual	13,781.6	14,138.2	15,017.8	16,433	16.839.8	17,804.8
Pounds water used, actual	114 846.6	118,295	125,156.3	136,941	140,331.7	148 273.3
Pounds water used iu run	110.646	114,035	120,956.3	132,541	136.131.7	144,173.3
Pounds coal used, actual	17,080	16,890	18,280	18,300	20,200	21,120
Pounds coal used in run	16,480	15,280	17,680	17,700	19,600	20,520
Pounds co al per car per mile	1.29	1.52	1.13	1.55	1.11	1.71
Coal consumed per 100 tons, hauled 1 mile	8 2	2.87	7.7	4.1	7.7	4.5
Tons hauled 1 mile per pound coal	12.1	25.8	12.8	24	12.8	22
Tons hauled 1 mile per pound water	1 81	3.46	1.88	3.21	1.88	3.13
Average evaporation per pound coal, actual	6.72	7.00	6.84	7.48	6.95	7.00
Factor of evaporation	$\frac{H - h}{965.7}$	Equals 1.17 average taken for all				
Equivalent evaporation from and at 212 degrees per pound coal	7.86	8.19	8.00	8.75	8.13	8.19
Per cent. moisture	1.5 in coal as weighed					
Equivalent evaporation per pound dry coal, average	8.28					



POWERFUL CONSOLIDATION LOCOMOTIVE FOR THE UNION RAILWAY,

THE LARGEST LOCOMOTIVE EVER BUILT.

THE PITTSBURGH LOCOMOTIVE WORKS, *Builders.*

CONSOLIDATION FREIGHT LOCOMOTIVES, UNION RAILROAD (CARNEGIE SYSTEM).

Through the courtesy of the Pittsburgh Locomotive Works we have received particulars of two enormous locomotives which they have just completed for the Union Railroad, a part of the Carnegie system. By referring to the tables published on page 1 of our January issue and page 296 of September of the current volume, it will be seen that these have the distinction of being the heaviest locomotives ever built. They weigh 208,000 pounds on drivers, and the total weight is 230,000 pounds. The cylinders are 23 by 32 inches, the boiler is straight with sloping back end and is 80 inches diameter at the front end, with other parts in proportion. The tubes are 2¼ inches diameter and 15 feet long, the firebox being 10 feet long and 3 feet 4¼ inches wide. It is 76 inches deep in front and 69 inches at the back, the material being Carnegie firebox steel. The front end is short, 68 inches, for such a big engine. The firebox is on top of the frames and the springs are over the driving boxes. The total heating surface is 3,322 square feet and the grate area 33.5 square feet. The driving wheels are 5.4 inches diameter and are of "steeled" cast iron, except the main wheels, which are of cast steel. The steam ports are 20 inches long. The engines are single expansion with extended piston rods.

The cylinders are of the half-saddle type, and the frame fastenings are very long. A steel plate 1⅜ inches thick and of the same width as the bottom of the saddle, extends across the engine and is bolted to the lower frames, and to this plate as well as to the frames the cylinders are securely fastened. Heavy bolts passing through the top frame bars and the front and back of the saddle form additional transverse ties, and relieve the saddle casting from tensile strains. Longitudinal strains usually transmitted to cylinders through the frames are largely absorbed by the use of a casting extended from the bumper beam well up to the saddle, securely bolted to the top and bottom front frames. This casting also acts as a guide for the bolster pin of the truck. This method of relieving cylinders of longitudinal stress was introduced by the Pittsburgh Locomotive Works nearly two years ago, and has proven, in practical use on a large number of locomotives, to be of great value in reducing breakage of saddle castings. The photograph shows three rows of bolts fastening the saddle to the smoke box. The frames are 4½ inches wide and have been cut from rolled steel slabs made by the Carnegie Steel Company and weigh 17,160 pounds per pair, finished.

The Union Railway, for which the locomotives have been constructed, is a part of the Carnegie system, connecting the Duquesne Furnaces, Homestead Steel Works and Edgar Thomson Steel Works, and extends, nominally, from Munhall to North Bessemer, Pa., a distance of about 12 miles. Some four miles of the line has a grade 70 feet per mile, while about 2,000 feet, from a point commencing at the yards near Edgar Thomson Steel Works, and passing up over the line of the Pennsylvania Railroad and ending at the foot of the 70-foot incline, there is a grade of 2.4 per cent. The locomotives are being operated daily upon this line, and steam freely, and, so far, appear not to be extravagant in the use of fuel and water. We hope soon to give some figures showing fuel and water consumption and tonnage hauled on the grades.

The following table gives the chief dimensions of the design in convenient form:

General Description.

Type	Consolidation
Name of builder	Pittsburgh Locomotive Works
Name of operating road	Union Railroad
Gauge	4 feet 8½ inches
Kind of fuel to be used	Bituminous coal
Weight on drivers	208,000 pounds
" truck wheels	22,000 pounds
" total	230,000 pounds
" of tender loaded	104,000 pounds
" total of engine and tender	334,000 pounds
Tractive power	53,292 pounds

Dimensions.

Wheel base, total, of engine	24 feet 0 inches
" " driving	15 feet 7 inches
" " total (engine and tender)	54 feet 9½ inches
Length over all, engine	39 feet 8¾ inches
" " " total (engine and tender)	65 feet 3½ inches
Height, center of boiler above rails	9 feet 3⅜ inches
" of stack above rails	15 feet 6 inches
Heating surface, firebox	205 square feet
" " tubes	3,116.5 square feet
" " total	3,322 square feet
Grate area	33.5 square feet

Wheels and Journals.

Drivers, number	8
" diameter	54 inches
" material of centers	Steeled cast iron
" " main "	Cast steel
Truck wheels, diameter	30 inches
Journals, driving axle, size	9 by 12 inches
" truck " "	6 by 10 inches
Main crank pin, size	7 by 7 inches

Cylinders.

Cylinders, diameter	23 inches
Piston, stroke	32 inches
" rod, diameter	4½ inches
" and valve stem packing	Metallic
Main rod, length center to center	9 feet 10½ inches
Steam ports, length	20 inches
" " width	1⅝ inches
Exhaust ports, length	20 inches
" " width	3¼ inches
Bridge, width	1½ inches

Valves.

Valves, greatest travel	6 inches
" outside lap	1 inch
" inside lap or clearance	0 inch
" lead in full gear	1-16 inch

Boiler.

Boiler, type of	Straight with sloping back end
" working pressure	200 pounds
" material in barrel	Carnegie steel
" thickness of material in barrel	⅞ inch
" diameter of barrel at front sheet	80 inches
" " " " " throat "	83½ inches
" " " " " back head	74⅝ inches
Thickness of tube sheet	⅝ inch
Crown sheet supported by stays	1⅛ inch diameter
Dome, diameter	32 inches

Safety valves: two 3 inch open pops and one 3 inch muffler.
Water supplied through two No. 11 injectors.

Tubes.

Tubes, number	355
" material	Knobbled charcoal iron
" outside diameter	2¼ inches
" length over sheets	15 feet 0 inches

Firebox.

Firebox, length	10 feet 0 inches
" width	3 feet 4½ inches
" depth, front	76¾ inches
" " back	69 7-16 inches
" material	Carnegie firebox steel
" thickness of sheets, crown	7-16 inch
" " " " sides and back	⅜ inch
" " " " tube	½ inch
" brick arch	Supported on studs
" water space, width,	Front, 4 inches; sides, 4 inches; back, 4 inches

Grates, cast iron, rocking pattern.

Smokebox.

Smokebox, diameter	83¼ inches
" length from tube sheet to end	68⅝ inches

Other Parts.

Exhaust nozzle	Single
" diameter	5¾ inches
" distance of tip below center of boiler	5⅝ inches
Netting, size of mesh	2 by 2 inches
Stack,	Taper
" least diameter	17 inches
" greatest "	18 inches
" height above smokebox	2 feet 9 inches
Track sander	Pneumatic

Power brake, Westinghouse, American.

Tender.

Type	With swivel trucks
Tank capacity, water	5,000 gallons
" " coal	10 tons
Kind of material in tank	Carnegie steel
Thickness of tank sheets	¼ inch and 5-16 inch
Type of under-frame	Steel channels
Type of truck	Diamond
Truck bolster	Rigid
Type of truck springs	Doule elliptic
Diameter of truck wheels	33 inches
" and length of axle journals	5 by 9 inches
Distance between centers of journals	76 inches
Diameter of wheel fit on axle	6⅜ inches
" of center of axle	5⅝ inches
Length of tender frame over bumpers	22 feet 11¼ inches
" " Tank	20 feet 6 inches
Width " "	9 feet 8 inches
Height of tank, not including collar	56 inches
" " " over collar	68 inches
Type of back drawhead	M. C. B. coupler

LOCOMOTIVE DESIGN—THE WORKING STRESS OF MATERIALS.

By Francis J. Cole.

Piston Rods.

The weakest part of a piston rod, and, consequently, where fractures usually occur, is at the crosshead connection. This can be accounted for by the reduced size of the taper part fitting in the crosshead, the cutting away of a portion for the key-slot, and the fact that a large percentage of crossheads are unbalanced and not symmetrical in weight, taking the longitudinal axis of the piston rod as a center. A bending stress in the rod at C, Fig. 1, is produced by the acceleration and retardation of the unbalanced weight at A, which is not entirely resisted by the guides, even when they are closely lined down with but little lost motion between them and the crosshead block. In cases where considerable lost motion exists, the entire bending stress has to be resisted by the piston rod at C.

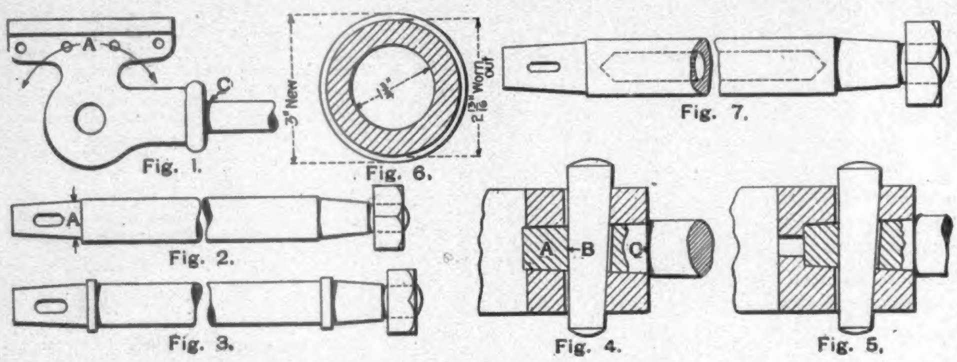
The form of rod which is probably used on more locomotives than any other design is shown in Fig. 2. The body is cylindrical, without collars at either end, its diameter being from ⅛ to ½ an inch more than the reduced taper fits on the ends. The main reason for the popularity of this type and its very extensive use, is that glands, bushings and packings can be used without cutting in two parts, in order to slip over a collar, the supposition being that the rod is worn out, when turned down or trued up, to a diameter equaling the large diameter of the crosshead fit. A much better form is shown in Fig. 3, which, by the use of collars at the ends, the taper crosshead and piston fits, may be sufficiently large without unduly increasing the weight of the rod.

Piston rods are subjected to tensile, compression, and, where an unbalanced crosshead is used, to bending stresses. The ends, however, which are fitted into the crosshead and piston head, are in tension only, the compression being taken up by the collar and taper fit and absorbed before the weakest part which is cut away for the key-slot is reached. The conditions for alternating strains need not then be considered for the ends, but only for the main part or body of the rod. The working stress per square inch of net area through the key-way or at the root of the thread should be 9,000 pounds for steel and 8,000 pounds for iron rods. Assuming that first-class material is used in both cases, steel of 75,000 to 90,000 pounds and iron of 52,000 pounds, the factors of safety would be:

$$\text{Steel } \frac{75{,}000}{9{,}000} = 8.33. \quad \text{Iron } \frac{52{,}000}{8{,}000} = 6.50.$$

Among some memoranda of actual failures which came under the writer's personal observation are these notes: On passenger engines, with 18-inch diameter cylinders, steam pressure 160 pounds, balanced crossheads, 3-inch diameter iron rods reduced to 2½ inches in the crosshead fit, breakages are frequent. Net area at key-way, 3.10. Stress per square inch $= \frac{40{,}640}{3.10} = 13{,}110$ pounds. On consolidation engines, with 20-inch diameter cylinders, 160 pounds steam pressure, Laird crossheads (unbalanced), 3¼-inch iron rods reduced to 3 inches in crosshead fit, breakages sometimes occur. Net area of key-way, 4.69. Stress per square inch $= \frac{50{,}240}{4.69} =$ 10,712 pounds.

As a general thing, it will be found that the stress taken at the weakest point—the key-way in the crosshead—will often run up to 12,000 or 13,000 pounds per square inch. Breakages are very common here, nearly always resulting in broken cylinder heads and flanges. Apart from the stress due to the steam pressure, the method of fastening the piston rod to the crosshead by means of a taper key driven to place has a tendency to overstrain the metal at the key-way and start incipient cracks, which, in time, are likely to extend and result in the breakage of the rod. In driving down the key the metal at A, Fig. 4, is compressed and that between the points B and C, is stretched. In extreme cases, where the key is driven with too great force, this may cause a crack to start in the key-way. A method of securing piston rods which has the advantage of not causing an initial stress by driving in the key is shown in Fig. 5. Here the compression caused by the key is taken up by the shoulder at the small end, and the metal in the key-way is not unduly stretched. It is an old idea, lately revived, and now undergoing a period of resuscitation. The expense of boring the crosshead and fitting the rod is, however, slightly more than the ordinary form.

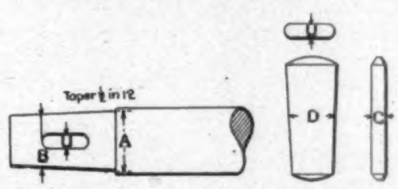


Diagrams of Locomotive Piston Rods.

The table which is given below is based on a working stress of 9,000 pounds for steel and 8,000 pounds per square inch for iron rods. The key-ways are from 5-16 inch for 1½ inch diameter of rod to ¾ inch in width for 3⅝ to 4 inches diameter of rod. In locomotives the stress which the rod has to resist should be taken as the area of the piston, multiplied by the maximum boiler pressure, without any deduction for the pressure of the exhaust steam on the other side of the piston. In single expansion engines this often does not amount to more than four or five pounds. In compound engines, of either the two or four-cylinder types, while the high pressure cylinder would show a considerable difference between the gross and the net actual unbalanced pressure on the piston rod when working as a compound, yet nearly all types, as at present constructed, are arranged to work as single expansion engines in starting, switching, and at other times when it is desirable to develop an unusual tractive power. The area of the piston, multiplied by the boiler pressure, should be used for single expansion and for the high-pressure cylinders of compound locomotives, and the maximum receiver pressure for compound locomotives. A suitable diameter of rod for either iron or steel can then be selected from the table. If the stress is kept within the limits named for the ends and the body of the rod is made the same size or larger than the dimension A, or the crosshead fit, it will be found that no other calculations as to the strength of the rod as a strut to resist buckling or bending are necessary, as the amount of metal in the body is more than sufficient for this stress.

The shearing stress for the steel key, or cotter, securing the rod to the crosshead, should be from 15,000 to 17,000 pounds calculated for single shear, or twice these figures for double shear. If steel of 75,000 to 85,000 pounds tensile strength which has sufficient elongation to insure its toughness, say, 18 to 20 per cent. in 4 inches, the higher figure can be safely used for widths of ½ inch or more. In case the keys are made of much softer steel—in the neighborhood of 65,000 pounds—the lower figure would be more suitable. It may be remarked, however, that the harder steel is better adapted for this purpose. Its use would indicate a better appreciation of this grade of material for work which must resist deformation in "keying up" and removing when the rod is disconnected, and for the bending stresses to which the key is subjected.

From a large number of different types of engines in actual service the shearing stress per square inch in single shear has been found to run from 9,000 to 22,617 pounds. The latter, however, is an exceptional case, 19,000 or 20,000 pounds being otherwise the outside figure, while the former is only found on very small engines. A noticeable tendency, however, to make the sizes entirely too large can be observed and out of all proportion on small engines, and to approach, without due regard to the stresses produced, the limit of safety in engines with cylinders of large diameters and high steam pressures. The bearing values in the key-way and on the key, figured from the sizes given in the table, range from about 16,000 pounds per square inch for the small sizes to 25,000 pounds for the largest. The latter figure is well within the limits of crushing and rapid wear for steels of the harder grade mentioned.



Least Dia. of Rod.	Dia. at "A."	Area at "B."	Key-way C.	Area of Key-way.	Net Area.	Working Stress.		Width of Key for Single Shear	
						Steel 9,000 lbs.	Iron 8,000 lbs.	of 15,000 lbs.	of 17,000 lbs.
Ins.	Ins.		Ins.					Ins.	Ins.
1½	1 7/16	1.35	5/16	0.41	0.94	8,460	7,520	1	....
1⅝	1½	1.48	5/16	0.43	1.05	9,450	8,400	1 1/16	....
1¾	1⅝	1.76	⅜	0.56	1.20	10,800	9,600	1⅛	....
1⅞	1¾	2 07	⅜	0.61	1.46	13.140	11,680	1 3/16	
2	1⅞	2.40	7/16	0.76	1.64	14,760	13 120	1¼	....
2⅛	2	2.76	7/16	0.82	1.94	17 460	15,520	1 7/16	....
2¼	2⅛	3.14	½	1.00	2.14	19,260	17,120	1 7/16	1¼
2⅜	2¼	3.54	½	1.07	2.47	22,230	19.760	1⅝	1 7/16
2½	2⅜	3 97	9/16	1.27	2.70	24,300	21.600	1 11/16	1⅜
2⅝	2½	4.43	9/16	1.33	3.10	27,900	24,800	1 13/16	1 9/16
2¾	2⅝	4 90	⅝	1.56	3.34	30,060	26,720	1¾	1 9/16
2⅞	2¾	5.41	⅝	1.64	3.77	33,930	30.160	1 15/16	1¾
3	2⅞	5.94	⅝	1.72	4.22	37,980	33,760	2⅛	1 15/16
3⅛	3	6.49	⅝	1.80	4.69	42,210	37,520	2⅜	2⅛
3¼	3⅛	7.06	⅝	1.88	5.18	46,620	41,440	2⅜	2 5/16
3⅜	3¼	7.67	11/16	2.15	5.62	50,580	44,960	2⅝	2 5/16
3½	3⅜	8.29	11/16	2.23	6.06	54,540	48.480	2 11/16	2½
3⅝	3½	8.61	¾	2.53	6 33	54,720	50,640	2 13/16	2 5/16
3¾	3⅝	9.28	¾	2.63	6.70	59,850	53.600	2 15/16	2½
3⅞	3¾	9.96	¾	2.72	7.24	66,160	57,920	3⅛	2¾
4	3⅞	10.68	¾	2.81	7.87	70,830	62,960	3 5/16	2⅞

In cases where it is desirable to reduce the weight of the reciprocating parts to the least possible amount, the body of the rod may be reduced to a diameter below that of the crosshead fit. The length between the piston and crosshead is about 35 to 36 inches for engines having 24-inch stroke. If it were practicable to reduce the diameter of the body from 3 inches to 2½ inches in diameter, the saving in weight for each rod would be about 22 pounds. The principal thing to guard against in thus reducing the diameter is the liability to bend next the piston head, caused by water in the cylinder. This is more apt to occur in horizontal locomotive cylinders than in vertical engines. The water settling in the bottom of the cylinder and being crowded up in the ends of the piston produces more bending stress in the lower half of piston, on account of the water not immediately spreading out and equalizing the pressure when sharply struck by the piston moving at a high velocity. The liability to buckle can be investigated by considering the rod as a column with a square bearing—that is, with flat ends. For a solid round section the least radius of gyration $= \frac{\text{Diameter}}{4}$. For a hollow circular section the least radius of gyration $= \frac{D + d}{5.64}$. In "Materials of Construction," Prof. J. B. Johnson shows that the ultimate strength of short columns is expressed by a parabolic curve, and is a function of the elastic limit of the material, and not of its ultimate strength.

Let l = the length in inches.
r = the least radius of gyration.
P = the ultimate strength.
E = the elastic limit of the material.

$P = E - .62 \left(\frac{l}{r}\right)^2$ for short columns of medium steel, with flat ends.

The following table for steel of 44,000 pounds elastic limit has been computed by this formula, and it will be found to cover the ordinary range for locomotive piston rods:

$\frac{l}{r}$	Ultimate strength per square inch.	$\frac{l}{r}$	Ultimate strength per square inch.
35	43240	65	41380
40	43008	70	40962
45	42745	75	40612
50	42440	80	40032
55	42126	85	39520
60	41768	90	38978

A factor of safety of 5, based on the size of the rod when worn out, would give about the proper strength, and at the same time reduce the weight of the rod as low as would be consistent with the required stiffness. Take the case of a rod 3 inches diameter in body and 2⅞ inches diameter at A, the crosshead fit. The working stress for this diameter, when made of steel, is 37,980 pounds. Assuming that the rod can be made 2½ inches diameter, the least radius of gyration will be .625, $\frac{l}{r} = \frac{36}{.625} = 57$. The ultimate strength in table for 57 is about 42,000. Then $\frac{37,980}{\frac{42,000}{5.}} = 4.5$ = an area equivalent to about 2 7-16 inches in diameter. Allowing 3-16 inch for wear, the rod would be 2⅝ inches diameter when new and about 2 7-16 inches when worn out. The difference in weight would be about 16.8 pounds.

It must also be remembered that this part is subjected to alternating stresses, which, if viewed simply as a short bar in tension and compression, without reference to any reduction in strength due to buckling, can be investigated as follows: Assuming that medium steel will stand an infinite number of reversals of the load, equal to one-third of its ultimate strength, when applied and completely relieved, then steel of 75,000 pounds tensile strength would stand 25,000 pounds per square inch when loaded in this manner: $\frac{25,000 \times 4.5}{37,980} = 2.9$, which is about as low a factor as good practice would indicate. This factor, however, should be carefully noted as differing materially from the ordinary factor of five, based on the ultimate strength, as it is more properly a factor of the elastic limit, and should be so considered.

For the least weight, combined with the greatest strength, a hollow rod is the most suitable. Its resistance to bending is so much greater than the solid circular sections that the area could be reduced to the requirements necessary to resist the direct stresses due to the piston thrust and pull, uncomplicated by bending and buckling. Taking the figure at 37,980, as before, and a factor of safety of 2½, the area required would be

$$\frac{37,980 \times 2.5}{25,000} = 3.79 \text{ square inches.}$$

2 13-16 dia. = 6.21 area

1¾ dia. = $\frac{2.40}{3.81}$ area when worn out, or 3 inches diameter when new. This is shown in Fig. 6, and shows a saving of 24 pounds in weight of each rod over the solid section 3 inches diameter.

While the hollow rod presents the ideal form for the purpose, combining lightness and strength, yet the cost of manufacture is so out of proportion to the results obtained that their use, although often proposed, is at present very limited. What would seem to be one of the best methods of making these rods is to use heavy steel tubing, with solid ends, welded in, as shown in Fig. 7. This would give the full strength of the solid rods at the ends, where the metal is reduced by cutting away for the key-way and threads.

COMMUNICATIONS.

THE METRIC SYSTEM, AS VIEWED BY AN AMERICAN IN RUSSIA.

Editor "American Engineer:"

I have read with interest Mr. Grafstrom's article on the metric system, and Professor Mendenhall's supplement to it in the September number of your journal (pages 289 and 244), and consider them very timely. The general adoption of the metric system by the manufacturing establishments of the United States is no longer solely a question of academic speculation or purely scientific interest, but, in view of the large and increasing shipment of American machinery into countries where the system is in gerenal use, it must be regarded as a live and important issue, which will, I feel confident, gradually force itself into such prominence that it must eventually be accepted. It has been my fortune during the last three years to have had a good deal to do with the management of large works where the metric system is used to a very great extent, but where the English units are also employed on some classes of work. For example, the diameter and pitch of all screw threads are figured in inches and fractions of inches, because the Whitworth system is in general use in the country, and our customers require us to conform to it. Having had practically no experience with the metric system until comparatively recently, many preceding years of intimate acquaintance with the two-foot rule probably made me somewhat biased against the millimeter and its multiples; but from almost the commencement of the time when I was called upon to work with the metric units my experience has been uniformly satisfactory. Calculations in the drawing-room are facilitated, strings of figures are more easily checked over, the rules of arithmetic are more readily complied with, and, most important of all, mistakes due to misreading of drawings in the shop are less frequent. The fact of there being two systems of measurement in the shop causes little or no trouble, and, certainly, if that is the case here, there would not be, to say the least, any more in an American establishment. It, therefore, seems to me that any opposition to the adoption, generally speaking, of metric standards in manufacturing concerns for everything, except possibly screw threads, is based either on prejudice, insufficient acquaintance with the working of the system, or from an exaggerated idea of the difficulties to be encountered and overcome while making the change from duodecimal to decimal standards.

The fallacy of the contention not infrequently met with, that because Great Britain has been the world's principal machine provider for so many years, while steadfastly rejecting the metric system, it is uncalled-for and unnecessary to suggest any change in its system of metrology, is so patent to an intelligent student of the international exchange of commodities that it seems almost incredible to find this discredited theory still seriously advanced, even by those who fail to appreciate the fact that times change, and unless we change with them, so much the worse for us. Great Britain's commanding position in trade was attained solely because she could furnish foreign nations with what they wanted in quantities, in quality, or at prices which practically allowed of no competition, and her system of metrology had absolutely no bearing on the matter. Within the last ten years, however, conditions have wonderfully changed. The United States, Germany, France and Belgium have all become commercial powers of magnitude; competition has been rendered very keen, and Great Britain has found that the methods of 25 years ago will not meet the requirements of to-day. In other words, she has begun to realize what an enormous difference there is between trade that came of itself and trade that has to be sought out. One reason for the relative falling off of British commerce has been the lack of adaptability of the manufacturers, the disinclination to change types or styles to suit special conditions. Cannot we learn a lesson from this?

American machinery has been shipped to Europe in large quantities during the past two or three years, and has, on the whole, made an excellent impression. But this market, like all others, must be cultivated carefully and assiduously, and one of the instruments of cultivation must be to fall in with the customers' wishes and requirements as fully as possible.

It would, of course, be foolish to assert that, because nearly all American manufacturers use the inch and foot in their shops and in their catalogues and give the weight of shipments in pounds, they are, therefore, going to have extraordinary difficulty in doing business with what I may call the metric countries of Continental Europe, which comprise about all there are, as well as that vast territory just opening up, Asiatic Russia; yet, I feel it would be a distinct advantage if all weights, dimensions, etc., submitted were given in metric units, and from now on every little point will count. If, then, it is going to be advantageous to work in the metric system for a large foreign trade, why should not the same system be applied at home? There are no insurmountable obstacles in the way.

W. F. DIXON,
Chief Engineer Sormovo Company.

Locomotive Department, Nijni-Novgorod, Russia, Sept. 12th, 1898.

THE DUMMY COUPLING.

Editor "American Engineer":

There is undoubtedly truth in many of the things that you say on the subject of the dummy coupling on page 341 of your October issue. I am somewhat in doubt myself, considering both sides of the question, whether it is advisable to keep up the dummy coupling or not. I surely think that the present dummy coupling is worse than useless, as even when it is in good shape it does not entirely exclude the dust. It is well known that it is very difficult, and almost impossible, to make freight trainmen hang up the hose. Furthermore, with the largely increased equipment of air brake cars it will be proven desirable to operate all air brake cars that are in trains, and that being the case it is going to be the exception rather than the rule to have hose hanging down in such shape that dust can be collected. The present shape of the coupling is such that when it hangs down there is no lodging place for dirt inside of the coupling; if grains of sand go in they will by jar of the train drop out again. There have been several devices brought out for automatically closing the opening. I think all that I have seen, barring one exception, are likely to be a source of as much trouble as they are benefit.

The one kind that I refer to is really by name and by make a dummy coupling, and it couples up in the same manner as an ordinary coupling, making an absolutely tight joint without the use of a rubber gasket. The Michigan Central Railroad people have had considerable experience with a device of this kind on their locomotives, and speak of it in high terms. I understand that the Westinghouse Company have been considering putting a device of this kind on the market in the place of their present dummy coupling.

For some reason there seems to be a quite general sentiment to the effect that there is less use for the dummy coupling now than there was formerly, owing to the proportionately small number of air hose out of use when cars are in service. I question whether the condition of triple valves will be very much improved by applying an effective dummy coupling over that at the present time with the hose hanging down, and with the hose equipped with the latest style of Westinghouse couplings, which leaves no lodging place for dirt. On the whole, I think the action of the M. C. B. Association was a wise one.

A. M. WAITT,
General Master Car Builder.

L. S. & M. S. Ry., Cleveland, October 10, 1898.

Editor "American Engineer":

I have read your editorial on the dummy coupler on page 341 of your October issue and I have given considerable attention to this matter of the dummy coupler latterly, for the reason that I am well aware that men in charge of the car departments of our large roads have abandoned its use.

This has led me to examine the condition of the hose that are not hung up in the dummy coupling, and I do not find them as clean as those which are hung up. In my opinion it is merely a question of disciplining the men by obliging them in all cases to hang the hose in the dummy coupling. One of the strongest points raised by those abandoning the dummy coupling, as I understand, is that the men will not hang the hose up.

I believe that this is a very useful addition to the brake mechanism, and if the couplings are attached to a link, and

that to an angle iron, and fastened to the cars properly, the gasket will find its bearing against the face of the dummy, and not kink the hose, but will give it a curve. Hanging the hose up, as above, will exclude all foreign matter which will affect the air brake mechanism.

If, however, the dummy couplings are removed and nothing substituted to cover the opening in the hose, more or less foreign matter will adhere to the inner tube of the hose, most of this foreign matter consisting of grit and fine sand. When the hose are coupled together this foreign matter will follow the air in the pipes and some will adhere to the strainers in the drain cup and triple valves, and, if not cleaned often, they will clog up, thus giving a slow action of the brakes, also a slow recharge of the auxiliaries. Some of the grit will also pass through the meshes of the strainers and cut the triple valve piston packing rings more or less, also the cylinder packing leather. Some of this grit is likely to get into the engineer's brake valve, becoming the cause of frequent repairs.

The kinking of the hose will shorten its life considerably, but with the dummy coupling properly hung, and causing the hose to curve, it will not cause the hose to depreciate enough to offset the extra expense of maintaining the brake mechanism with the hose hung down and the dummy coupling removed.

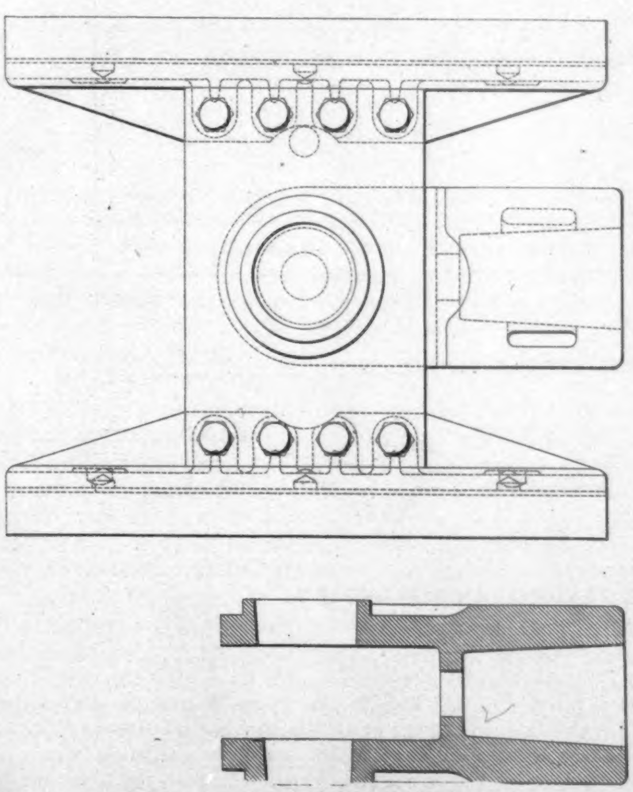
J. T. CHAMBERLAIN,
Master Car Builder.

Boston & Maine R. R., Boston, October 10, 1898.

THE BREAKAGE OF PISTON RODS.

Editor "American Engineer."

On page 340 of the October number of the "American Engineer," there was an article about breakage of piston rods due to the rocking of the crosshead, with some suggestions as to making the piston rod flat at the crosshead end in order to allow it to bend slightly without fracture. I enclose a blue



Articulated Crosshead—N. & W. Ry.

print showing what we consider to be a more desirable way of obviating the difficulty.

In this design the wrist pin connects the rod and crosshead center as usual, but the center itself is able to rotate within the sliding portion of the crosshead, so that any rocking of the latter would not be communicated to the rod, as a bending strain, the small amount of vertical motion being allowed for in the vibrating cup of the metallic packing. This is accomplished by forming bosses or trunnions on the forged steel center, which trunnions fit into the side plates of the crosshead in such a manner as to allow of a rotation of the latter independently of the center. The plates are bolted to and connect the shoes to each other. We have had a pair of such crossheads running for 18 months, and the only difficulty has been a horizontal wear between the bosses and the side plates, which has had to be taken up by bushing. If the plates and trunnions were made thicker, this trouble would probably be obviated, and we believe that the device would absolutely prevent the breakage of piston rods from the causes assigned in your article above referred to.

G. R. HENDERSON, Mechanical Engineer,
Norfolk & Western Railway.

Roanoke, Va., October 10, 1898.

[The design of crosshead referred to by Mr. Henderson was illustrated in the "American Engineer," June, 1897, and owing to the interest in the subject, and Mr. Henderson's testimony after the experience of an additional year, we reproduce the engraving.—Editor.]

LOCOMOTIVE GRATES.

Editor "American Engineeer":

I have read with great interest Mr. M. N. Forney's admirable article entitled "Locomotive Grates" in the current issue of the "American Engineer," and I hope that Mr. Forney will favor your readers with more articles of a similar character in the near future. The statement of the general problem confronting the locomotive designer in the matter of obtaining, within the available limits of weight and space, the most efficient boiler for a given locomotive, is excellent; as is also the explanation of the causes which render a relatively small grate area, large heating surface and large cubical contents of fire-box, conducive to the best evaporative efficiency of a locomotive boiler.

The design of grate which Mr. Forney illustrates apparently possesses an important advantage over the ordinary type from the standpoint of fuel economy, provided it develops no objectionable features in service, such as warping of the bars, becoming inoperative through the lodgment of cinders and clinkers, and provided, also, that enginemen can be induced to use it as intended, which, judging from their habitual neglect of the damper as a draft regulator, appears somewhat doubtful. However, this last is a matter of discipline, not a mechanical defect.

The following possible objection to the device occurs to me, but I mention it merely as a suggestion. If a locomotive equipped with the above type of grate is operated for the greater part of the time with a considerable portion of its grate area non-effective, and it is only occasionally necessary to utilize the entire grate area for active combustion (for instance, assume a road with severe adverse grades, separated by long stretches of comparatively level track), it seems probable that during the former period the fire above what is virtually a dead plate would die out, and that, consequently, a good deal of difficulty might be experienced by the fireman in again bringing to incandescence, particularly with poor qualities of coal.

Whether or not this objection is valid can, of course, only be satisfactorily determined by an experiment, although some opinions may be formed by those having had experience with dead plates, as ordinarily applied; but in any event the device appears well worthy of trial upon a locomotive, and I hope to see it tried.

EDWARD L. COSTER,
Assistant in Mechanical Engineering, Columbia University.
New York, Oct. 7, 1898.

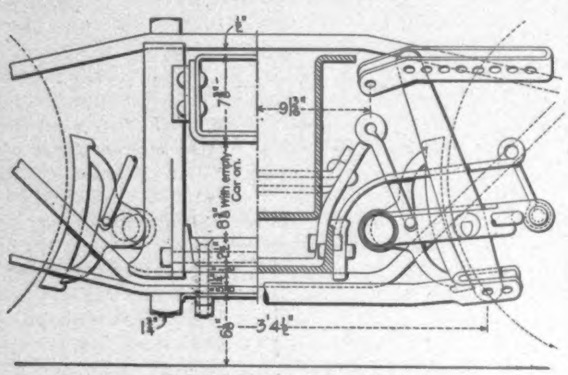
The use of oil as a scale remover in steam boilers is treated in an article in a recent issue of "The Locomotive," the conclusions of which are summed up as follows: Mineral oil is often useful for the prevention or removal of scale, when it is properly applied; in the prevailing method of introduction, it gives good results in many cases; but when it has not proved as effective as desired, we recommend that the boiler be dried out and that the kerosene be sprayed upon the plates and tubes. It is important to avoid the use of open lights in or about a boiler that is being so treated; incandescent electric lights are the safest to use. Finally, kerosene is very serviceable for removing lubricating oils from plates and tubes.

PRESSED STEEL BODY AND TRUCK BOLSTERS.

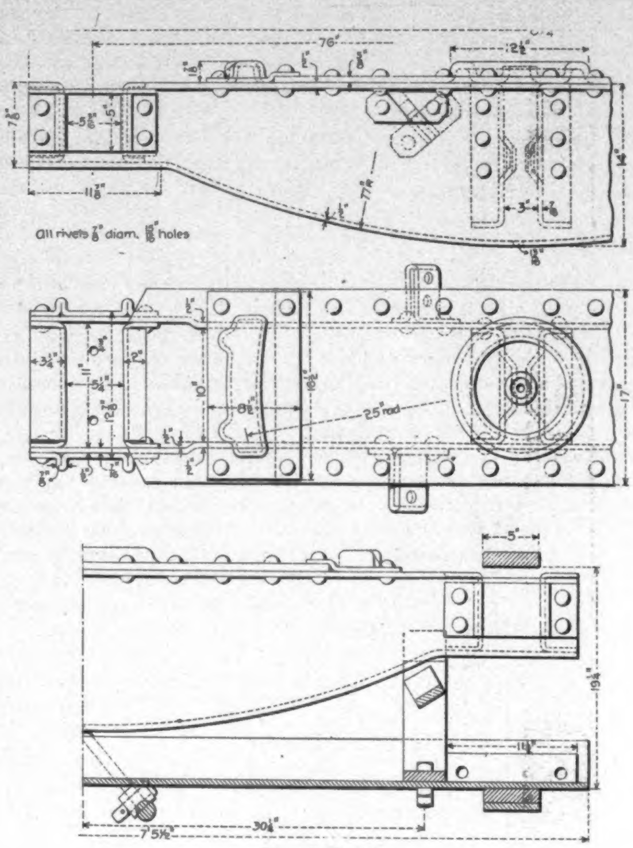
PENNSYLVANIA STANDARD.

Designed at Altoona and Built By the Schoen Pressed Steel Co. for the Vandalia Line.

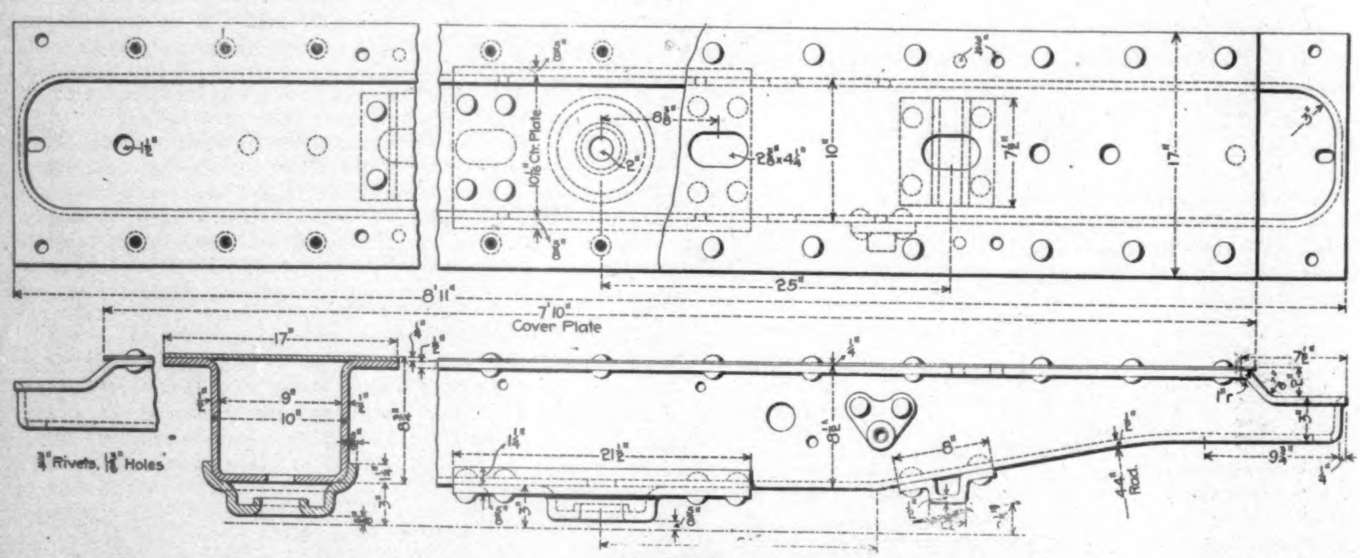
Through the courtesy of Mr. W. C. Arp, Superintendent of Motive Power of the Terre Haute & Indianapolis Railroad, the Vandalia Line, we have received the drawings of the new body and truck bolsters for 80,000 and 100,000 pounds capacity cars, from which a number have been built. The truck, with the exception of the axle, is for use under cars of both of the above-mentioned capacities. The design was made by the motive power department of the Pennsylvania Railroad at Altoona, and is the standard of that road, and the Vandalia Line, being a part of the Pennsylvania system, is using the same standards. The axle shown is the recent M. C. B. design



Partial End View of Truck.



Truck Bolster.



Body Bolster.

SCHOEN PRESSED STEEL BOLSTERS, PENNSYLVANIA STANDARD.

for 80,000-pound cars, and will not be used under cars of larger capacity. The bolsters are manufactured by the Schoen Pressed Steel Company, of Pittsburgh, Pa., and as shown in the engraving, the truck is of the diamond pattern. The weight of the truck bolster is 760 pounds, that of the body 606 pounds and that of the channel spring plank is 270 pounds. The method of constructing the bolsters is clearly indicated in the engravings, and it is only necessary to state that they are made in the form of covered troughs of ½-inch steel, pressed into shape in dies. The main portion of the bolster of each type is made in one piece with wide flanges which receive the cover plates. The brakes are inside hung, the manner of attachment being shown in the end view and section. The center plates, side bearings, center braces, and in fact all attachments are of pressed steel.

A LONG "BURLINGTON" TRAIN.

Oct. 1 was Chicago Day at the Trans-Mississippi Exposition in Omaha, and all of the railroads ran special trains, carrying delegates of the different Chicago organizations attending.

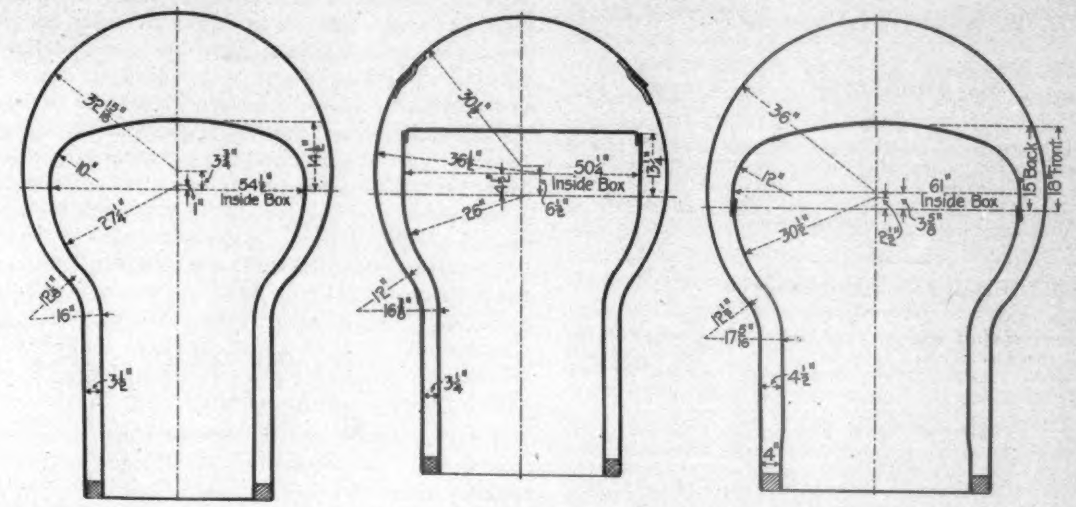
Among these was a special which left over the Burlington, and it was the longest train of Pullman cars that ever left Chicago on a regular run. It consisted of seventeen Pullman cars, one special private car, one baggage car and two engines.

The train shed at the Union Passenger Station, which is the longest one in Chicago, measures 1,100 feet, but the train measured exactly 1,337 feet, or more than a quarter of a mile long, and it started for Omaha at 2.30 p. m., scheduled to run at forty miles an hour. The weight of this caravan on wheels was estimated to be 22,290,000 pounds, or about 1,145 tons, and the two engines to pull the train over the 500 miles to Omaha burned 45 tons of coal and transformed into steam 53,000 gallons of water.

LOCOMOTIVE STAYBOLTS.

The difficulties with broken staybolts do not decrease, and there is more anxiety concerning them as the use of high pressures increases. We have endeavored to keep pace with this subject, and are forced to the conclusion that the only remedy for broken staybolts is to use stayless boilers, and this may yet be done. The pressing question is, how to reduce the present difficulties.

The form of the firebox, its depth and the lengths of the staybolts have very important influences, and some rather conclusive information on this subject has been gathered in a comparison of three different forms of fireboxes on three classes of engines on the Chicago & North Western Railway. The first, class C 5, has a crown bar boiler, carrying 150 pounds of steam, and has deep and narrow water spaces. The second is class C 6, with radial stays and a deep firebox with narrow water spaces, carrying 180 pounds of steam. The third, class A, is the largest boiler used for this service, and until very recently the largest on the road. The class A locomotive was illustrated in our issue of January, 1896, page 4. It has a shallow firebox on top of the frames, and carries 190 pounds of steam. The three designs may be compared by means of the diagrams, which we reproduce to approximately the same scale, and in order to see the effects of the form, the relative depths of firebox and width of water leg should be noted. The class C 5 firebox is 72 inches long, the class C 6 is 74 inches long and the class A 96 inches long, inside. The length probably exerts some influence on the number of broken staybolts, but it does not seem likely that this would make much difference in these three boxes. The largest box would have more staybolts if it were of the same style and depth as the others, but in this case the number of staybolts was about the same in all classes.



Class C-6. Class C-5. Class A.

Effect of Firebox Construction on Staybolt Breakages.

A careful record of the broken staybolts for all engines is kept, and that for 18 class C 5, 10 class C 6 and 24 class A engines for six months shows the following:

Class C 5, 124 staybolts broken, or an average of 7 per engine; class C 6, 226 broken, or an average of 22.6 per engine, and class A, 32 broken, or an average of 1 1-3 per engine. It is interesting to note that the breakages on the class A engines were confined to 4 engines, 20 of the engines being entirely free from them for the entire six months. These fireboxes were not as long in service as the others, but the ages are not far different and are not believed to have made the comparison in the least unfair. The same may be said of the mileages. There were six out of 18 of the class C 5 engines free from breakages, and only three out of the 10 of class C 6.

The class C 6 firebox, which is small, with radial stays, made the poorest record, notwithstanding the fact that they were used in a district where the water was excellent and much better than that for the other engines. The crown bar firebox did not make a bad record, and the big, shallow firebox made the best of all. There are at least two reasons to account for these results, and we think them important. The water space should be enlarged as much as possible, in order to increase the length of the staybolts and to increase their flexibility, and the depth of the firebox, from the beginning of the shorter bolts, should be as little as possible. Shortening the sides will decrease the expansion and contraction, which is believed to be one of the most destructive influences that staybolts have to encounter.

The distribution of the broken bolts in the different classes of engines is given in the table, and it will be noted that the front sheets have the smallest numbers. The back sheets have nearly as many as the side sheets.

SUMMARIES.

Class.	Number of Engines.	Front.	Back.	Right.	Left.	Total.
A	24	8	7	9	8	32
C5	18	9	34	45	36	124
C6	10	14	71	73	68	226

The fact that there were 20 of the first class with no breaks and 6 of the second and 3 of the third, is curious, and it would be valuable to know why these did not show some broken. There did not seem to be any evidence of different conditions in these cases, and we do not know the reason.

THE ANTI-SCALPING MOVEMENT.

An anti-scalping campaign was inaugurated at a meeting held in Chicago October 6, called by the directors of the National Association of Merchants and Travelers. By a unanimous resolution it was decided to appoint a central anti-scalping committee, with sub-committees in every large city to push the anti-scalping movement to a conclusion. Able addresses were given by Mr. Paul Morton of the Atchison, and Mr. George H. Daniels of the New York Central. Mr. Morton characterized scalping as "commercial savagery," and it could not be honestly conducted. He deplored the prevalence of legislation adverse to railroads, and showed that the interests of the roads were identical with those of the people. Scalping was one of the reforms most urgently needed.

Mr. George H. Daniels was introduced as the "father of the anti-scalping movement in the United States." He was glad to see the organization of business men take up the work, and the result of co-operation with the railroads in this movement was sure to benefit the whole traveling public. A number of men well known in the business world spoke in plain, strong terms in favor of squelching the scalpers, the result being the passage of the resolutions already referred to. The movement is gaining strength continually, and it is evident that the scalper must go.

(Established 1832)

AMERICAN ENGINEER CAR BUILDER AND RAILROAD JOURNAL.

29TH YEAR. 67TH YEAR.

PUBLISHED MONTHLY
BY
R. M. VAN ARSDALE,
MORSE BUILDING..NEW YORK

G. M. BASFORD, Editor.

NOVEMBER, 1898.

Subscription.—*$2.00 a year for the United States and Canada; $2.50 a year to Foreign Countries embraced in the Universal Postal Union.*
Remit by Express Money Order, Draft or Post-Office Order.
Subscriptions for this paper will be received and copies kept for sale by the Post Office News Co., 217 Dearborn Street, Chicago, Ill.

EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Special Notice.—*As the* AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL *is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 20th day of each month.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

The paper may be obtained and subscriptions for it sent to the following agencies: **Chicago,** *Post Office News Co., 217 Dearborn Street.* **London, Eng.,** *Sampson Low, Marston & Co., Limited St. Dunstan's House, Fetter Lane, E. C.*

The dummy coupler for the air brake equipment of freight cars was discussed editorially last month, and elsewhere in this issue will be found some expressions of opinion on the subject from the men who know. One of our correspondents is very sanguine about the equipment of all cars with air brakes in the near future. There is good reason to believe that some of the trunk lines will soon have all of their cars so fitted, but there are comparatively few roads having the necessary facilities for storing and inspecting air brake cars, and these must be provided before the cars are all equipped. This will take time. Furthermore, the law does not require all the cars of freight trains to have air brakes, and there are good grounds for thinking that the interval between the present condition and total equipment will be a long one, although the brakes will in time be applied to all cars. During this interval there will be a great deal of mixing of cars with and without air brakes, and it is apparent that a good dummy coupler will be useful for some years. What Mr. Waitt says about the dirt dropping out of the new couplers is true, but it must be remembered that comparatively few freight cars have this coupler, and there will always be trouble with ice when air hose is allowed to hang.

In this issue will be found the views of Mr. W. F. Dixon, Chief Engineer of the Locomotive Department of the Sormovo Works at Nijni-Norgorod, Russia, upon the metric system in its effect upon our foreign trade. These are formed in the light of European opinion of American machinery, and his opportunities for understanding the commercial importance of the subject are unusual. Mr. Dixon is an American and well known to many of our readers. He puts the matter on a commercial basis, and believes that our trade with metric countries will be benefited by the use of units that are most convenient to the customer. The export trade will not stop if English units are adhered to, but if it may be increased by so easy a method the business sagacity of our own manufacturers will not fail to accept the necessity for using metric units in business with metric countries. Mr. Dixon says of England: "She has begun to realize what an enormous difference there is between trade that came of itself and trade that has to be sought out. One reason for the relative falling off of British commerce has been the lack of adaptability of the manufacturers, the disinclination to change types or styles to suit special conditions. Cannot we learn a lesson from this?" The lesson is that it will pay to use metric units in catalogues, correspondence and designs for that trade. If this leads ultimately to the general adoption of the same units at home the situation will be simplified. Manufacturers will undoubtedly be glad to have the benefit of Mr. Dixon's experience.

MUST THE DISTANT SIGNAL GO?

Signal engineers and others have for a long time been discussing the usefulness and the dangerous character of the distant signal, yet no conclusion seems to be reached, and it will be interesting to see how long it will continue. One recommends doing away with these signals altogether, substituting a fixed sign-board to indicate the approach to an interlocking plant. He considers the function of the distant signal to consist in merely indicating the location of a danger point. He also believes that the distant signal as now generally used is a source of danger. Another would continue the signal, but would locate it 3,000 feet, or more, back from the home signal, and would require trains to pass it under control and maintain a relatively slow speed up to the home signal. This would delay all trains passing such signals, and in order to lessen this objection the distant signal would be used only where the view of the home signal is obscured.

These views seem to be unprogressive. They do not cover what may be called the primary principles of railroad signaling, namely, to promote high speeds with safety. Instead of delaying trains, signals should enable them to run faster and with safety. The distant signal itself is innocent enough. It is misused and needs to be safeguarded. This signal is required at all interlocking plants which are passed at high speeds. It should be located a sufficient distance from the home signal (1,200 feet is not enough for all cases); it should be kept in perfect adjustment and repair, and it should be connected to electric locks on the route governed by the signal. It is most important that the signal should be used and not abused, as is now too generally the case. If it is safeguarded in this way, it is hard to conceive how the distant signal can be anything but what it is intended to be—a help to trains and an element of safety.

STEEL FOR AXLES, CRANK PINS AND PISTON RODS.

Steel vs. iron for axles, crank pins and piston rods is an old story, the prejudice against steel having operated to delay its use by many as long as possible. At first steel was a very uncertain material, likely to fail, and generally unsatisfactory. Besides the matter of chemical composition, always an important one, those of manufacturing methods and fiber stress, both internal and external, have been studied, and now

steel parts which have been specially treated to correct the faults of constitution and manufacture may be had and used with confidence. The word prejudice is used advisedly, because there is even now a tendency to remember early and unfavorable experience, with a danger of overlooking the improvement in steel.

In European practice steel has almost entirely replaced iron for axles, and good wrought iron is becoming so difficult to obtain as to compel the use of steel whether desired or not. The cost of the special steels is said to be greater than that of iron, but this is not always true when the frequency of unavoidable defective forgings is considered. In visiting a shop on a road using iron pins almost exclusively, the number discarded was surprising, and the most expensive feature of the defective work is that often it does not develop until after having been some time in the lathe, when a seam will open, making it necessary to throw the piece away. This experience was also confirmed at one of the large locomotive works, where even after cleaning scrap in a tumbling barrel to remove the scale and dirt a large proportion of the forgings are not used on account of seams.

More attention is now given to the vital factors of fiber stress, elastic limit and ability to withstand repeated stresses, and these will decide the selection of material for the future. There are good reasons for improving the quality of axles and pins, not the least of which arises from the increasing weight of locomotives, and the axle problem, particularly, bids fair to be a difficult one. The most natural way to increase strength is to enlarge the diameter, but this may be carried too far on account of the increased surface velocity of the journals, and this is favorable to a stronger material, which may be either an alloy like nickel steel, or a product of a special process of manufacture like the "Coffin," which relieves the structure of initial stresses and raises the elastic limit without increasing the ultimate strength.

It is necessary to use great care in the preparation of specifications for steel, because of the intimate relations between chemical composition and physical properties, and it is possible that some purchasers have stood in their own light by specifying certain chemical composition which made it impossible to secure the desired physical properties. We know of one case of this kind that was used as an argument in favor of iron. Axles made by a special process were furnished in accordance with chemical specifications and barely met the physical tests. On machining them in the shop they were found to be hard and difficult to finish. In such a case it would be better to allow the manufacturers to use their own specifications on a guarantee of the quality of the product. Such a course would probably result in a more rapid introduction of steel, and in constant improvement in its quality.

The treatment of steel in the shop is important, and steel has been condemned because of mistakes in handling it in the machines. In one case a failure resulted from too high a speed in the lathe, which on examination was found to be over 20 feet per minute for the finishing cut, when the best practice with extra heavy lathes on the same material is 19 feet per minute for the roughing cut, and from 14 to 16 feet on the finishing cut. Often the best economy is found not in using the maximum speed, but in sacrificing speed in order to maintain a heavy cut, which heats the tool less. It seems in many cases to be good practice to work hard and slow. The desired end is to remove the maximum amount of metal in a given time, and this may be better done on a strong, stiff machine by a heavy cut and rapid feed and low-cutting speed than by light, fast cutting. The rate of cutting has had little to do with the adoption of steel, but what has been said serves to show that there may be good reasons for difficulties with steel for which the material itself was not in any way responsible.

The "mysterious" failures of steel are less frequent with more experience. The effect of light hammers is now well understood, and there is no longer any reason for accidents like that of the fracture of the shaft from the U. S. despatch boat "Dolphin." It will be remembered that specimens cut from this shaft after failure showed 21.4 per cent. elongation at the outer edge, and only 2 per cent. near the center, the difference being due to the fact that the shaft was forged with too light a hammer, which was unable to affect the material to its center. There is no excuse for such failures now, nor is there any reason for similar ones with axles and pins. Good steel may now be had, but of course at a little higher first cost. Low first cost has undoubtedly been too much in mind in the purchase of these materials.

THE ADJUSTMENT OF PRICES OF CAR REPAIRS.

The adjustment of the prices which a railroad is allowed to charge a car owner for repairs to cars requiring them when away from home, in order to take into account the variations in the cost of material and labor in different parts of the country, is one of the most difficult problems now confronting the Master Car Builders' Association. The Western members brought the question up at the 1897 convention by showing that the cost of labor and material was more in the West than in the East, and that the prices provided for by the interchange rules were so low as to cause injustice to the Western roads, because they had to pay more to repair a car than they could charge for the work. The matter was reopened this year, and it is very important that it should be settled at the earliest possible moment. We do not presume to offer a solution, but we think we can state the case clearly from both sides, and thereby assist in an understanding of the situation, and this is the beginning of a solution.

The trouble is caused by the necessity for interchanging equipment, and the fact that the distribution of cars is such as to take a great many more of the Eastern cars West than there are Western cars coming East. If the distribution was even between the two sections, the roads would in effect be repairing a large number of other people's cars instead of an equal number of their own, but this is not the case. The number of Eastern cars used for through shipments from the East is much greater than the number of Western cars that go to the East.

For convenience the geographical division decided upon in the request for an adjustment is the 105th meridian. The Eastern representatives think that the use of their cars on the Western roads at a low rental of six mills per mile compensates the Western roads for their loss through the cost of repairs, and there is a great deal of opposition against establishing the precedent of a differential rate for any particular part of the country, because in a short time "they will all want it, and it will make lots of trouble." The East would like to keep its cars at home because of the necessarily rough usage they get on the Western lines, and they believe the extra wear and tear due to handling on mountain grades should not fall upon the owner.

It is said that Western cars are repaired in the East at lower rates than the owners would pay at home, this and the mileage of foreign cars being held to balance the matter of differences in prices. In regard to the mileage factor, Mr. Bush at the recent convention offered the following argument:

> We have an average mileage rate for ordinary freight cars which covers the entire country. That rate is six mills per mile. It is very low. The average value of a car is $400. The interest on that is $24. The average mileage of freight cars on twenty-three of the principal roads of the United States is twenty-one miles per day. That gives a mileage of 7,560 miles a year. The return rate of six mills per mile is $45.36 to the owner. Out of that he has to pay for the cost of maintenance, and included in that cost is the item of depreciation, and the renewal of cars worn out. At the very lowest four mills per mile will not cover the cost, and it will reach over five mills, as the cost of maintaining, including renewals, cars being destroyed, etc. Now assuming that it is over four mills for maintenance, that will mean $30.24 per car per year. Admitting that the revenue received from the car is $45, you have $15

as the return on your investment. The railroads west of the 105th meridian are getting the benefit of that exceedingly low mileage rate. As Mr. McConnell showed by his figures, they are using more foreign cars than the mileage of their cars on Eastern roads, and his road and all the others in that section of the country are getting the benefit of that exceedingly low mileage rate, which I claim compensates them for any difference in the cost of making repairs, but even if it did not they would have to take their own equipment to do the business they are doing to-day with foreign cars. They would pay exactly the same amount of money and more to maintain their own equipment than they are paying to-day. In addition to that they could not get a fair return on their investment. The fact of the matter is, I believe the Western roads are ahead on account of being able to rent cars at a low mileage rate. I cannot bring myself to believe that it is any way just to make this differential rate.

The reply to this is that the mileage taken by Mr. Bush is too low to fairly represent the condition in the West. The Western roads claim to be getting the worst of both the mileage and the repair ends of the question. They say that twenty-one miles is too low a daily average, and this is supported by a record of an average of forty-five miles per day, taken for a month on the Union Pacific recently.

The East admits the greater cost of repairs to the West, but advances the argument that the entire cost of operation is greater, and it is balanced by higher freight charges. We have not heard this point answered as yet.

The Western men say: "We desire only fairness. We receive Eastern cars on our lines loaded with freight that is destined to distant points on our lines, and the cars must receive necessary repairs, which we make at a loss, because our rates for wages and materials are 31 per cent. more than the rules allow, whereas Eastern roads can get the actual cost of repairs from the car owners owing to their more favorable location with regard to wages and prices."

The Western men admit that they are hauling a great deal of freight in foreign cars, but they say that they do not want foreign cars at all, even at a low mileage rate, because they have their own cars lying idle while using those of the Eastern roads. One Western road handled 45 per cent. of its through business in foreign cars last year, and it is interesting to know that 29 per cent. of the mileage of these cars was non-productive, owing to the cars being empty. They do not want to use other people's cars even at six mills and would prefer to transfer all through freight to their own cars at the interchange points. This cannot be done because of expense and delay, and besides there is a great deal of freight that cannot be transferred owing to lack of facilities for handling it. The Eastern roads derive as much, if not more, benefit from the direct transfer of the car and its load, and the question of the Western men is: "Why, under these circumstances, should the Western roads be obliged to repair these cars at a loss?"

That this problem is intricate must be apparent to those who have followed us thus far. It is evident that the Master Car Builders' Association is not the final court for the case. If this is not already apparent, it will become so when the factor of the private car lines is considered. The element of reciprocity that constitutes the basis for the present claim of the Eastern men to fairness in the matter is lacking in the case of the private car lines, whose cars are repaired by both Eastern and Western roads at the same prices. This illustrates the inconsistency and incongruity of the situation better than anything else we know of. What we think of the merits of the case does not matter, and we do not consider ourselves competent to judge, but we believe that if any subject demands the consideration by General Managers this one does. The Master Car Builders cannot decide it alone without committing an error to correct another error, and this never has and never will work well. The appointment of a committee representing Eastern and Western, as well as private car lines, was a wise step, and the best course for the committee is to consider the question from the point of view of the Treasurer and Auditor, who have information necessary for a solution that is not to be had from the car departments.

NOTES.

A speed of 40.8 statute miles per hour is reported for the Chinese torpedo boat destroyer "Hai Lung," built by the Chichau Works at Elbing, Germany. The trials were made on a 19-knot course in the open sea and in moderately rough water. Several runs were made, the average speed being 35.2 knots, which is equivalent to 40.8 miles per hour.

H. M. S. "Terrible" has just completed extensive trials, during which the vessel traveled 6,000 miles and there were very few mishaps. In commenting upon the results "Engineering" says: "The trial certainly showed that no difficulty would be experienced in crossing the Atlantic at over 20 knots speed." While developing 25,115 I. H. P. the coal consumption was 2.11 pounds per horse power hour, including all auxiliaries.

The coal consumed in making scrap iron car axles at the Southern Pacific shops, as stated by Mr. D. Uren, before the Master Blacksmiths' Association, is 0.46 of a pound (bituminous) per pound of iron heated. The scrap is heated in four piles of 600 pounds each. These are roughed down the full length under the steam hammer, after which one half of the axle is heated and finished, and then the other half is treated likewise, three heats being required. The work is claimed to be improved enough by the heating to justify it.

Progress in railroad signaling in this country seems to tend in the direction of improvements in construction, in the substitution of iron and cement foundations in place of oak, and in the use of iron signal poles in place of wooden ones. These are very important improvements in the line of permanent structures to take the place of those which, under the most favorable conditions, can last only a few years. Electric locking, as applied to interlocking signals, is also making headway, and it may be said to meet with considerable favor. The effect of this is to increase the safety afforded by signals by surrounding them with a much-needed safeguard.

The largest schooner ever built is now being timbered at the shipyards of H. M. Bean at Camden, Maine. The vessel will have five masts and will be 318 feet long on deck, 44 feet 4 inches beam and 21 feet 6 inches deep. The frames are Virginia oak and the planking Georgia pine. Her masts will be 112 feet long, the foremast being 24 inches diameter and the others 28 inches. The spread of canvas will be 10,000 square yards. This large vessel will be manned by only 12 men. She will have electric lights, searchlight and steam hoisting appliances.

The development of long distance electric railways is now progressing in the direction of connecting the systems of cities that are not widely separated and extending them into interurban lines of considerable extent. The latest and longest line of this kind was described in our October issue, and as it may probably be considered as a type of long distance railroad transmission for further development, it is a specially interesting case. The transmission system finding most favor at present uses polyphase transmission current with converters and direct current motors. The Chicago & Milwaukee line is interesting also on account of the good ideas carried out in the power house, in the steam plant and in fact in the entire system for the purpose of guarding against a blockade from a breakdown.

Inclined planes with easy gradients have been substituted for stairways in the new railroad station recently opened in Providence, R. I. This new station is the outcome of efforts of 20 years to improve the passenger terminal facilities of that city, and the result is considered a decided success, the credit for which is due to Messrs. George B. Francis and Edwin P. Dawley, who have planned and executed the work for the New York, New Haven & Hartford Railroad. The plans included

raising the entire station yard above the surrounding street level by bridging and steel structural work, the elimination of a number of grade crossings, the filling in of a body of water, "The Cove," and the diversion of a tide channel. The structural work and bridges are an example of construction which, we believe, for permanence and solidity, is not surpassed anywhere in this country.

The air cylinders of locomotive air brake pumps are usually jacketed. This makes the steam and air ends uniform and improves their appearance, but the jacket tends to retain the heat, and if the jacket is tight the heat insulation is good enough to cause the packing of the air piston to burn out. The Boston & Maine, and probably some other roads, make a practice of removing the jacket and substitute a sheet of perforated plate smoke box netting. This is taken from scrapped netting, and it gives a good appearance without retaining the heat. It is a good plan, and there seems to be no reason why the air cylinders should not be finished in such a way as to look well without any covering. The steam cylinder and also the steam pipes should of course be insulated, but the air cylinder should be kept as cool as possible. This will benefit the packing and improve the efficiency of the pump.

The lessons drawn from the war by Admiral Sampson, in an interview printed in the Boston "Journal," are worthy of special attention on account of his exceptional opportunities for forming opinions, and also because of his experience as an ordnance officer. The Admiral would not only have warships fireproof, but he goes farther than that, and believes in discarding wood practically altogether. He sees no reason to condemn torpedo boats. They have not had a fair trial, and those that were used were not correctly designed. He prefers stronger boats and sees no advantages in speeds higher than 25 knots. Rapid fire guns 8 inch and smaller did practically all of the damage to the Spanish ships, and, while advocating rapidity of fire, he points out the fact that the armor of the Spanish ships was thin, and if it had been thicker larger calibers would be necessary. The 12-inch gun is, therefore, defended. Smokeless powder is strongly advocated. It permits of seeing what is going on and also offers the advantage of 400 feet per second in velocity over ordinary powder. A total of over 12,000 men were engaged in the service of the warships, and there were only 20 casualties among them. This is unprecedented, and the Admiral believes it to be due to the fact that our navy is on a perpetual war basis, including the supplies departments, and the effectiveness was due to the target practice.

Strengthening the Master Car Builders' coupler is the subject of an article in the October issue of the "Railway Master Mechanic." The objections which have arisen to the coupler since its adoption are not to condemn the coupler to disuse, because "with all its faults, we have it still," and the important question is, how to improve it and avoid some of the objectionable features, the effects of which are, perhaps, greatly exaggerated. Attention is directed to the fact that the close coupling feature of this type has contributed in an important way to the introduction of the continuous brake, and it was shown in the Burlington brake tests that the brakes could not be applied on 50-car trains without this feature. The article describes the recent experiment on the Chicago, Burlington & Quincy in strengthening the coupler knuckle by reducing the width of the link slot from the customary practice of 2¼ to 1½ inches. The slot was originally made wide enough to admit pilot bars, but as these have practically gone out of use, the width is reduced in order to strengthen the lower lug of the knuckle, the upper lug being unchanged. In commenting upon this experiment, the suggestion is made that perhaps the gain in strength may be offset somewhat by possible binding of links that may be coupled to these knuckles, particularly in case of using links of large diameter iron. Furthermore, records show that only four per cent. of the breakages of knuckle lugs occur in the lower lug. The opinion is expressed that a width of 2¼ is unnecessary, and the attempt to improve the knuckles is commended as "an earnest effort in which every master mechanic should be working—that is, the strengthening of the M. C. B. coupler."

ROLLING STOCK EQUIPMENT IN THE UNITED STATES.

From summaries which will appear in the Tenth Statistical Report of the Interstate Commerce Commission, prepared by its statistician, being the complete report for the year ending June 30, 1897, the following advance figures are obtained:

The total number of locomotives in service on June 30, 1897, was 35,986, the increase in number as compared with the preceding year being 36. Of the total number of locomotives reported, 10,017 were classed as passenger locomotives; 20,398 as freight locomotives, and 5,102 as switching locomotives. The number of locomotives not classified was 469. The total number of cars of all classes reported in service on the date named was 1,297,480. The corresponding number for the previous year was 169 greater. Of the total cars reported 33,626, or 623 more than for 1896, were assigned to the passenger service; 1,221,730 were assigned to freight service, indicating a decrease of 157 during the year; and 42,124 were assigned to the special service of the railway companies. As has been stated in former years, the Division of Statistics has no record of the number of cars owned by private companies and individuals that are used by railways in transportation service.

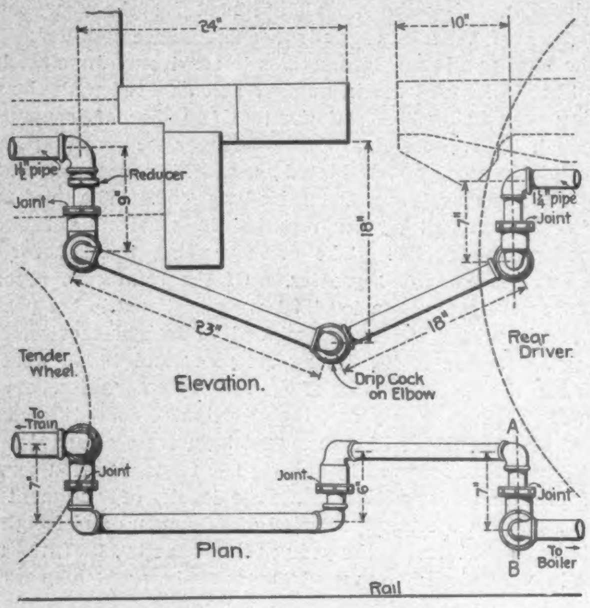
From summaries which indicate the density of equipment and its efficiency in the transportation of passengers and freight, it is observed that during the year ending June 30, 1897, the railways in the United States used 20 locomotives and 708 cars per 100 miles of line. Taking the United States as a whole, it appears that 48,861 passengers were carried and 1,223,614 passenger-miles accomplished per passenger locomotive, and correspondingly there were 36,362 tons carried and 4,664,135 ton-miles accomplished per freight locomotive. All of these items show a decrease as compared with those of the preceding year. The number of passenger cars per 1,000,000 passengers carried during the year under consideration was 69, and the number of freight cars per 1,000,000 tons of freight carried was 1,647. It should be understood, however, that this average does not include such cars, mainly in the freight service, as are owned by private parties, for the use of which the railways paid during the year approximately $11,000,000. Including in the term equipment both locomotives and cars, it is found that the total equipment of railways on June 30, 1897, was 1,333,466. These figures are 133 less than on June 30, 1896. Of this total number 525,286 were fitted with train brakes, the increase being 76,432; and 678,725 were fitted with automatic couplers, the increase in this case being 133,142. These increases are somewhat smaller than the corresponding increases for 1896. It should be noted, however, that the number representing the increase in equipment in that year was over 27,000. Further details as to equipment on June 30, 1897, show that the number of passenger locomotives fitted with train brakes was 9,899, or 83 more than the preceding year. The number of freight locomotives so fitted was 18,796, or 875 more than the preceding year. The number of switching locomotives fitted with train brakes was 3,666. The number of passenger locomotives fitted with automatic couplers was 4,687, the increase with respect to 1896 being 184. The number of freight locomotives fitted with automatic couplers was [illegible], the increase being 819. The number of switching locomotives fitted with such couplers was 741, or 147 more than for 1896. The number of passenger cars fitted with train brakes on June 30, 1897, was 33,078, and the number fitted with automatic couplers was 32,661, the increase in the one case being 665 and in the other 815. The number of cars in freight service fitted with train brakes was 453,688, or 74,630 more than on June 30 of the previous year. The number fitted with automatic couplers was 629,399, indicating an increase of 129,166. Of the total cars in service 492,559 on June 30, 1897, were fitted with train brakes, and 668,937 were fitted with automatic couplers, the increase for the year in the former case being 75,237; in the latter, 131,989.

METALLIC ROD PACKING AND FLEXIBLE METALLIC STEAM HEAT CONDUIT—BOSTON & MAINE R. R.

Mr. M. P. McLaughlin, of the Boston & Maine R. R., has perfected and patented two devices which have been adopted for general use on that road, and have also been applied to a number of engines on other roads. They are both highly spoken of by Mr. Henry Bartlett, Superintendent of Motive Power.

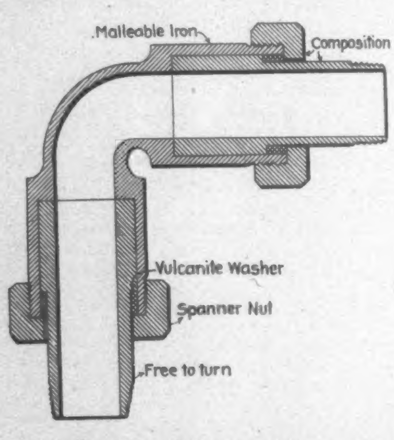
Flexible Steam Heat Conduit.

This arrangement is for the steam heat connection between locomotives and tenders and between cars. The illustration



Plan and Elevation of Steam Heat Conduit.

shows it connecting a locomotive and tender. The joints in the pipe are made by swiveling elbows. A nipple, with an enlarged end, is inserted in the bore of the elbow, and is free to turn therein, but is held in place by a cup nut, against which the shoulder, or enlargement of the elbow, bears. A ring of vulcanized rubber is inserted between these surfaces to make the steam-tight joint and to provide for taking up wear. While adapted to and used for a large number of purposes requiring flexible connections, the most severe test has

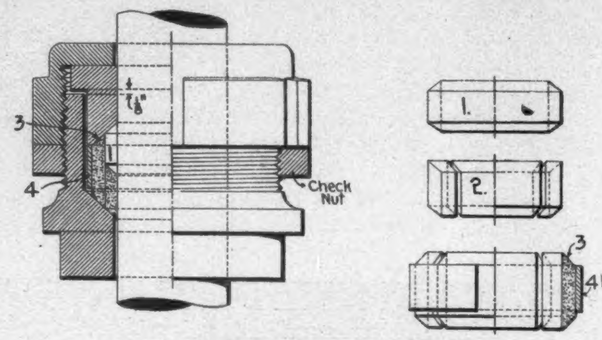


Section of Swivel Joint.

been made in connecting locomotives and tenders for steam heating. In this exacting service the arrangement has given excellent satisfaction for a period of a year and a half. It wears well and does not leak. The construction is shown in the engravings.

Metallic Rod Packing.

The metallic packing is for piston rods and value stems. It consists of two concentric rings of "anti-friction" metal, each of which is split longitudinally to put it in place, and the ends are formed into conical bearing surfaces. The inner ring is divided circumferentially into two abutting portions, and the outer one is encircled by a flat steel spring to keep the packing together and to assist in making it tight. When applied to air pump piston rods the packing is inserted in the regular stuffing box with a gland of such length that when brought to a bearing on the packing the flange of the gland is not quite in contact with the end of the stuffing box. When put into service the nut is gradually turned up until the gland bears on



Metallic Rod Packing.

the end of the stuffing box. The packing will then run for a long time without attention. It is used on a large number of air pumps, and the usual life is from 18 months to two years, or between the shoppings of the engine for general repairs. Its use has also resulted in a marked decrease in the wear of the piston rods. It is equally successful on valve stems and locomotive piston rods.

CHILLED WHEELS FOR 100,000 LBS. CAPACITY CARS.

In view of the interest taken by railroad officials at the present time in the question of large capacity cars, a pamphlet recently issued by the New York Car Wheel Works, of Buffalo, showing tests on wheels suitable for 100,000 pounds capacity cars, is most timely.

It goes without saying that the heavier loads will produce internal strains in wheels when brakes are applied many times greater than ever before experienced, and it is a question whether the standard 550 pounds or the 600 pounds wheel now used under 60,000 pounds capacity cars will stand these strains.

It would seem to be a simple matter to increase the weight of the wheel proportionately, but this would necessitate making the plates of the wheel that are now ¾ inch thick, from 1 to 1½ inches thick, and this would make uniform cooling difficult and would induce shrinkage strains.

The New York Car Wheel Works have approached the problem from the standpoint of an increase in strength in the iron used and the pamphlet describes tests made on wheels weighing 650 pounds intended for use under 100,000 pound capacity cars, to demonstrate that the necessary strength had been obtained.

The series of tests made rather naturally divide themselves into three groups:

First, the drop tests, Nos. 1, 2, 3 and 6; second, the bursting tests, Nos. 4 and 7, and, third, the thermal test, No. 8.

The first group shows not only the transverse strength of the iron in the wheel, but its ability to successfully stand the severe shocks and blows of service.

A radical departure was made from the ordinary Master Car Builders' test used exclusively in this country by subjecting the wheels to the test required under the specifications of the leading European railroads for steel wheels, and one is at once struck with the far greater size of the weights employed and the height from which they are dropped. It is

interesting and instructive to compare the force of the blow struck in foot pounds in each case. In the Master Car Builders' test this is 1,650 foot pounds, while in the Austro-Hungarian it is 9,500 foot pounds, and in the French State Railway 30,800 foot pounds, or over 18 times as severe as the test ordinarily employed in this country. That chilled wheels can be made to withstand such severe tests shows a very decided step in advance in wheel manufacture, and the pamphlet shows that the wheels not only stood the number of blows required under the specifications, but in every case more than double that number.

The second, or bursting, group demonstrates the ability of the wheel to stand internal strains, and it will be noted that a steel wedge with a taper of 1 in 20 was driven into the segmental bushing fitting the bore of the wheel by 13 blows of a 475-pound weight, without cracking the wheel.

In the test with the tapering steel axle, where the pressures were recorded, 100 tons was reached without causing the slightest crack in the hub or plates.

The thermal test was intended to reproduce the heating

Special 33-inch, 650-lb. Pittsburg, Bessemer & Lake Erie Railroad Wheel.

In position for first blow under German State Railway specifications. Hub bored to receive conical steel sections with interior tapering steel wedge, machined and fitted.

action due to the application of the brakes and to demonstrate that the wheel would successfully stand the severe strains thus induced. In reality the thermal test, as made in the tests described, was many times more severe than anything that would ever be found in service, owing to the fact that the molten iron ring is at a temperature approximating 2,600 degrees, while the wheel is at the temperature of the atmosphere. In the two minutes in which the band is in contact with the tread the temperature of this portion is raised to about that of the ring, while the temperature of the hub and plates was practically unchanged.

The enormous strain induced will be better appreciated when it is considered that the expansion of the wheel during this test caused an enlargement of its diameter of ⅜ inch, all of which had to be taken up by the metal in the rim and a portion of the single plate.

In actual service the heating due to brake application is so gradual that time is given for its penetration into the double

33-inch, 650-lb. Special Wheel After Thermal Test.

plates, frequently as far as the hub, and thus the strain is distributed over a much larger surface.

In a future issue we shall give a result of the tests made on the wheels placed under the 100,000 pounds capacity steel hopper cars built for the Pittsburgh, Bessemer & Lake Erie Railroad, the wheels being made by the New York Car Wheel Works and the tests by the Carnegie inspector.

THE AMERICAN RAILWAY ASSOCIATION AND THE METRIC SYSTEM.

The committee of the American Railway Association on the metric system, at the recent meeting in New York, made a report, of which the following is an abstract:

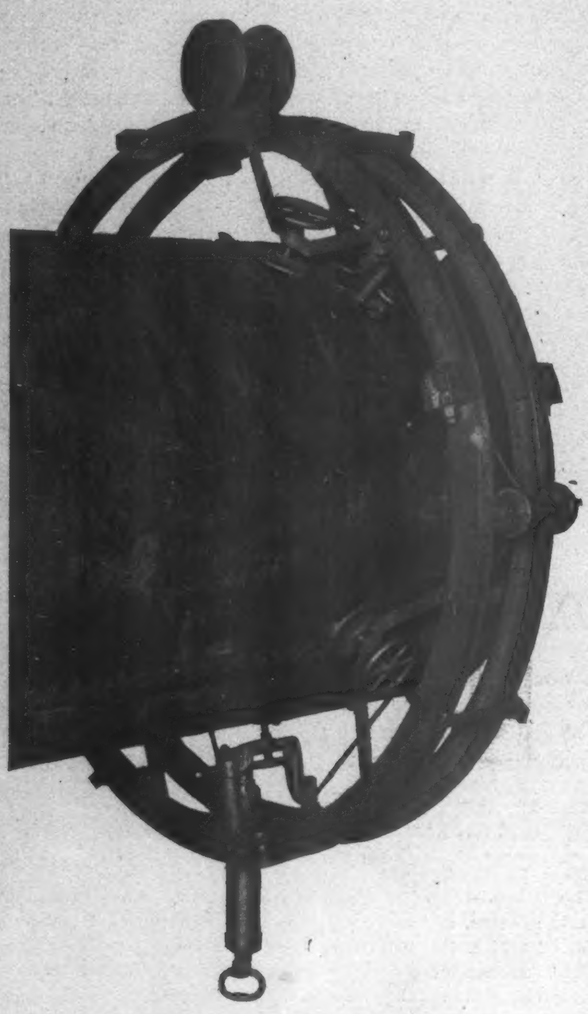
"The events of grave and national importance that have transpired during the past six months, which may result in changes in the foreign relations of the country, have been used as an argument by those who favor the adoption here of the metric system. It is claimed that unless our manufacturers make their goods according to the metric weights and measures they will be handicapped in their competition for foreign markets. Whether such arguments will be forcible enough to create a general demand for the change to the metric system is a question that your committee does not feel called upon to discuss. If, however, such a demand should arise from any cause, it would be important that our railway officials should know what it would be necessary for them to do in making the change.

"Your committee has, therefore, under consideration a plan by which it hopes to be able to report upon the methods which it would be necessary to employ in the introduction of the metric system in each railway department. This would include an examination into the difficulties to be overcome and the expense involved in changing from one system to another. If your committee succeeds in obtaining the desired information the association will have data before it from which the whole question can be more intelligently discussed in its relation to railway operations.

"Some of our manufacturers have recently inserted in their publications special tables of metric dimensions. Your committee will endeavor to ascertain to what extent this is being done, and report upon the subject at a future meeting."

PNEUMATIC RIVETING ON A LARGE SCALE AT ONE-FIFTH THE COST OF HAND WORK.

The use of pneumatic riveters in shipyard, bridge shop and other equally important engineering work is one of the greatest of recent improvements in these lines. The success is due to the rapidity of operation and convenience of the tools and careful examination of the quality of the work is convincing as regards its satisfactory quality. We have repeatedly directed attention to the value of pneumatic tools and to the economies which their use permits. A remarkably good demonstration of these features is at hand in the record of the construction of a long hydraulic pipe line in San Francisco, Cal., by the Risdon Iron & Locomotive Works of that city. Our engraving illustrates the ingenious riveters used in this work



Moore's Portable Riveter.
THE CHICAGO PNEUMATIC TOOL COMPANY.

and known as "Moore's Patent Portable Riveters," manufactured by the Chicago Pneumatic Tool Company of Chicago. The construction of the machine and the method of driving the rivets are shown in the engraving, and the record of the performance is given in a letter from the works, who were the contractors, to Mr. John W. Duntley, President of the Chicago Pneumatic Tool Company. This is a strong indorsement after a very severe test, and it is specially worthy of note that the operation of the machines was successfully intrusted to boys. Notwithstanding the difficulty of the work it was done at a cost of one-fifth of that of hand labor, and the necessity for employing expert boiler makers with the attendant dangers of labor difficulties was avoided. The quality of the work is reported as "far ahead of any work that can be done by hand." The letter is as follows:

"In reference to the use of Moore's patent portable riveters, we have to state we have used these machines on a contract just completed by us for the Spring Valley Water Company of this city for over 30,000 feet of 44-inch riveted pipe, varying in thickness from ¼ to ⅜ inch. Each machine was operated by two boys, one on the outside of the pipe operating the pneumatic hammer, the other on the inside of the pipe operating the pneumatic holder-on.

"The pipe was shipped from our works in 30-foot lengths, and on account of the hilly country in which the pipe was laid a large number of bands was found necessary in order to make the pipe conform to the ditch. The air was supplied to the machine through a line of 2-inch gas pipe from a compressor attached to a portable boiler on wheels, and the compressor was not shifted until the air line was over 5,000 feet from the compressor to the riveting machines, at which length the loss in the pressure was hardly perceptible.

"Each machine (and we had two on the line) drove 200 1½-inch hot rivets per hour. This quantity was not varied in very hilly places, where the machines were operated at an angle of 30 degrees without the slightest inconvenience.

"The cost of doing the work by means of this portable riveting arrangement was but one-fifth of what it cost by hand, not to say anything of the numerous annoyances avoided as regards the labor element. Work of this character has heretofore been confined to boilermakers, who have insisted on the highest wages while engaged on the work, together with their board and lodging, fares and time traveling back and forward from the work. Even with these concessions we have had innumerable strikes from the skilled workmen employed on the job.

"In the case of riveting by portable riveter, the highest wages paid was $2 per day, and not a skilled man was employed on the work. The rivets driven showed by actual test to be far ahead of any work that can be done by hand.

"THE RISDON IRON & LOCOMOTIVE WORKS."

"San Francisco, Cal., Oct. 4, 1898.

ELECTRIC CAR LIGHTING FOR THE SANTA FE LIMITED.

The "Axle Light" system of the National Electric Car Lighting Company has been selected for use on all the cars of the Santa Fe Limited, running a distance of 2,265 miles from Chicago to Los Angeles. As a result of the satisfactory service given by this system on about 60 cars on this road, extending over nearly two years, the Pullman Company, on September 26, made a contract with the National Electric Car Lighting Company for this application, the first equipments to be ready for service on Nov. 2.

The contract with the Pullman Company is an extensive one. It includes equipments for four complete trains with nearly 5,000 candle-power for each train, besides electric fans and probably also electric lamps for the headlights of the locomotives. Each of the trains consist of three sleeping cars, one dining car, one library car and an observation car. The sleepers have berth lamps, a feature that is very popular with travelers, and electric fans may be used whenever desired. The trains will undoubtedly be as well, if not better, lighted than any others, and this equipment is the most extensive and complete application of the National Company's system of lighting by power from the axles. The light is now being rapidly placed on every car on the Santa Fe which does night service, and five United States mail and express cars, operating on the Gulf, Colorado & Santa Fe, have also been ordered equipped.

The system of "axle lighting" has been described in these columns, and the company has lost no opportunity and has spared no expense or trouble to improve its system, with a view to rendering its service reliable, and the maintenance and operation of the equipment simple and cheap. Storage batteries are used, but they receive their charges from the axle dynamos, and do not require charging, or changing of position, at the terminals. The regulating apparatus is entirely

automatic, and by a special system of winding the dynamos and arranging the circuits the lighting may be left almost entirely alone while the train is on the road, the lighting circuit switches being practically the only parts requiring attention. That is to say that the lights need only to be turned on or off as required. No current is generated at speeds below about 12 miles per hour, and the current may be used directly from the dynamo to the lamps if desired. The advantage of independence of the lights of each car is urged as a strong claim for the system, and the storage feature renders it possible to light and ventilate the cars when detached from the engine and from other cars. If the equipment of a car is crippled, however, it may be lighted from the next car by means of connecting conductors.

The Los Angeles service is exacting, because it involves round trips of 4,530 miles, with six nights on the road. The reports received are sufficient ground for believing that the system is entirely satisfactory.

Two very severe tests have recently been made with the apparatus of this company. A dining car and a library car were attached to the transcontinental train at Los Angeles, Cal., carrying the Knights Templars to Pittsburgh, Pa., and without any preparation, or, in fact, any previous notice of the trip, these cars, fitted with the National system, were sent out. They had no attention, except for lubrication, and made the trip in good order. The other case occurred with Mr. Depew's private car, which carried him from New York to Omaha and return, a distance of 3,000 miles, with the apparatus that has been in use on the car since last spring. Absolutely no notice was given and no preparation made. Since his return from Omaha Mr. Depew wrote a letter to Mr. Max E. Schmidt, President of the National Company, which we have seen. It expresses entire satisfaction with the lighting and the electric fan systems on this car. This and a similar communication from Mr. E. P. Ripley, President of the Atchison, Topeka & Santa Fe, tend to show that the claims of the company are substantiated.

ACME TRIPLE BOLT CUTTERS.

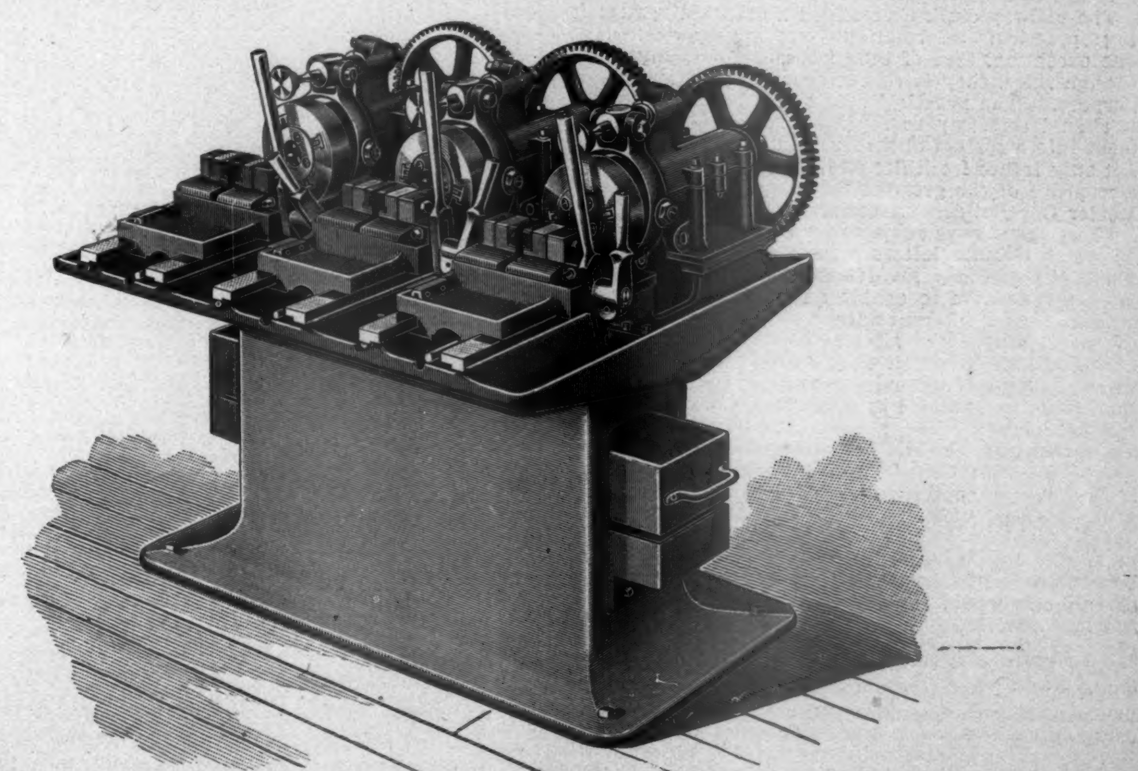
The machine shown in the accompanying engraving is made by the Acme Machinery Company of Cleveland, Ohio. It is designed especially for manufacturing purposes, with reference to producing the maximum output with the minimum care and attention, and the design was made for the purpose of building a machine which shall produce as much work as a single operator is able to handle and still run the machine at a speed which will give it a satisfactorily long life, at the same time doing good work.

The machines are built in two sizes, known as 1-inch and 1½-inch. They are very compact, and the parts are arranged to be within easy reach of the operator. Holes are provided in the bed directly under each head, allowing the oil and chips to fall in a pan which has a screen bottom and capacity sufficient to hold the chips of the day's work, where they may be left to drain over night and the pan drawn out and emptied in the morning. The carriages are long, giving ample bearing. The long levers move the carriages, and the short ones close the vises and are adjustable to any angle. This makes the movement of both carriages and vises very rapid and easy.

The machine heads are the latest type "Acme," using this firm's well-known form of die, which is made with extra long die-rings, lined, with tool steel blades throughout. The heads are about 5 inches shorter in total length than the usual form of Acme head. The yoke which opens and closes the head is locked by a toggle placed between the lower end of the yoke and the head stock. The upper end of the yoke is connected with a nut that works on a screw having a knurled head, and the dies are thus adjusted to size without stopping the machine, by means of the knurled head screw. The toggle is controlled by a rod passing through a bracket on the carriage; this rod carries two adjustable collars, which are set to open and close the head automatically. The dies are made so that they may be easily renewed by the users. They are constructed in such a way as to insure a good thread, and the builders guarantee them to do so.

The arrangement permits of running the machine as a single, double or triple one at will. Examination of the machines shows that the best of material and workmanship are employed, and the capacity is stated to be one-third greater, with a single operator, than that of any double machine ever built, and at the same time the work is of the best. These objects have not been attained by high speeds of operation, and we are told that the rate of speed is slower than is usual with this class of machinery.

The weight of the inch machine is 3,000 pounds, the floor space required being 4 feet 6 inches by 4 feet 2 inches, and the speed of countershaft 175 revolutions per minute. The weight of the 1½-inch machine is 3,800 pounds, the floor space 5 feet 2 inches by 4 feet 10 inches, and the speed of countershaft 160 revolutions. The manufacture of bolts is a part of the shop work of every railroad, and it is important that it should be carried on on a "manufacturing basis."



Acme Triple Bolt Cutter.

WHAT THE RAILWAY CLUBS MIGHT DO.

An idea that has been prominently advocated in the development of the railway clubs is the ultimate utilization of these institutions as a gathering place where members of all branches of railroad service may represent their views and arrive at a more perfect state of harmony on debatable questions than invariably obtains. While such a result might be desirable, there seems to be little promise of its speedy realization and, in fact, at the present time the active members of railway clubs are chiefly connected with the motive power department, and, with a few exceptions, they discuss motive power problems, while still holding out an invitation to other departments to bring forward subjects of mutual interest.

In view of the fact that such organizations as the Signal Club and the associations of track and bridge men afford their members opportunities for discussing the subjects in which they are principally interested, it would appear questionable whether the present railway clubs will ever successfully broaden their field to any great extent, and it is entirely possible that they would attain their highest utility by adhering to the cause to which they have so far been devoted—the exploitation and discussion of motive power department problems. Questions which affect several departments must from their character be generally settled in a railroad office rather than a club.

For some reason probably connected with the character of their work and the variety of methods by which it may be accomplished the representatives of mechanical departments are more willing than any others to devote time to regular meetings, and it cannot be admitted that there is any lack of important subjects for discussion. The mechanical field is broad enough, and in one direction club development has to a large extent been neglected. The literature of the clubs is very valuable and the proceedings have a worth peculiarly their own, recording as they do the experience of the men who are actually engaged in carrying out the operations about which they talk, whereas in many of the technical associations the debaters are men holding positions that are of the directive or executive order, and while the statements of such men, especially as regards problems of a broad or scientific nature, are not to be disparaged, they have the disadvantage of being largely second hand as regards the details that are of such importance in railway work.

The railway clubs thus afford a splendid system for obtaining practical information on any question, but with one exception, that of the discussion of changes in the interchange rules, they have not been systematically used for any purpose. The practical result of this experiment shows that it should certainly be repeated, and it is capable of development into a system of research into many subjects that would not only infuse fresh life and energy into the clubs, but would also prove of the greatest value to the Master Mechanics' and Master Car Builders' Associations.

There are always subjects for committees of the associations on which circular letters requesting information are sent out. Some of these may involve extensive tests or access to tabulated information to enable an intelligent reply to be given; others are of a different nature, seeking rather the united opinion or experience of all who are handling or working with the apparatus to which they refer. In the latter instance it would be difficult to devise a more effective method of inquiry than could be obtained by discussing such questions before the railway clubs. The present circular letters are anything but satisfactory, as can be immediately shown by noting the number of replies received, and while no doubt in many cases a good deal of conscientious research is undertaken, there are also instances where replies are made in a more or less haphazard fashion. Even a Master Mechanic or Superintendent of Motive Power is hardly infallible, and answers may have been made to the best of the respondent's belief when a further inquiry would have developed facts that would have modified his opinions. Now, if information of this description is required, the members of the committee might easily be chosen so that each would be in a position to introduce the subject as a topical discussion before one of the clubs. If put in the form of papers, printed beforehand, with the understanding that each club was expected to do its part in forming the national opinion, there is no doubt that much valuable information could be obtained that is not now obtained at the annual conventions. Each member would feel that he was doing his part in assisting to form the report that would finally be made to the greater association, and this feeling should give an objective point to the proceedings of the clubs and encourage each individual to do his best to bring forward some fact of importance or formulate his experience, knowing that his efforts were not simply wasted or likely to be forgotten, but would occupy their place in the final report according to their worth or reasonableness. The facts brought forward in this way, if not replacing those obtained from the circular letter, would certainly form a most valuable addition to them and would put the committee in possession of information gathered from wide sources that could not fail to make reports far more representative than is the case at present.

There are not enough subjects that could be handled in this way to seriously interfere with the discussion of questions of immediate or local interest, and as a general thing the difficulty is to obtain papers on suitable subjects. A scheme such as is outlined above might be profitably introduced by collaboration between the secretaries of the clubs and the two associations, and a system that would be a most valuable adjunct to the letter of inquiry might be formulated, which would bind the clubs into an organization that should have a continual reason for existence and prove an encouragement to all to bring forward their individual opinions. H. H. V.

CAR WHEEL IRONS AND THE THERMAL TEST.

The thermal test of chilled cast iron wheels is likely to exert an influence over the manufacture of wheels which renders it desirable to secure all available information on the relations between the tests and the manufacture of wheels. In the July, 1898, issue, page 249, we presented portions of a report by Mr. S. P. Bush, Superintendent of Motive Power of the Southwest System of the Pennsylvania Lines, and some comments upon it contributed by Mr. Guy R. Johnson of Embreville, Tenn., to "The Iron Trade Review" are reprinted as follows:

Chemical Composition of Wheel Irons and the Thermal Test. —In one of our technical journals I notice a report of Mr. Bush, on thermal tests for car wheels. I have read it with much interest, as the furnace of which I am manager makes a specialty of car wheel iron. It is a pity that these tests were not given in a little fuller form. Mr. Bush gives only a group of 20 wheels, 10 of which stood the test, and 10 of which did not stand the test.

From the figures given, Mr. Bush draws the conclusion that there is no evidence of chemical composition to show that the chills of wheels which stand the heat test differ from the chills of wheels which do not stand the test, so far as their properties depend on the chemistry of the metal. It is unfortunate, as I said before, that full chemical analyses were not given. Certainly there is nothing in the tables of carbons furnished to indicate the difference, but may there not have been in some of the other elements?

The result of a great number of experiments carried on at this place, under my supervision, would seem to indicate that both phosphorus and sulphur have a very marked effect on the ability of a wheel to stand the thermal test. We have found that if the phosphorus runs much over .40, the interlacing chill feature, which is characteristic of good wheel iron, is absent—this, with normal sulphur. We have found, though, still further, that high sulphur, i. e., much over one-tenth, has a distinctly deleterious effect on the chill, seemingly neutralizing to a large extent the effect of the low phosphorus in causing an interlacing chill. Furthermore, there are two ways of getting a chill: One, and a correct one, is to use low silicon, low sulphur, and low phosphorus, making silicon the ruling element; the other is to disregard, to a certain extent, both silicon and phosphorus, and obtain the chill by means of sulphur. The latter chill presents one broken and straight line, or demarkation, between the gray and chilled irons.

There is very little question that the strains in the chilled portion of the iron are greater than in the gray. This being the case, unless fingers of chilled metal run down into the gray metal, it is very easy to see that the thermal test would cause the white iron to crack away from the gray.

Without wishing to pose as an authority on the manufacture of wheels, I may add that I have understood from some of the users of this test, that wheels made of the proper kind of metal, with a good interlacing chill, do not yield to the thermal test, but that wheels made with very high sulphur and high phosphorus are exceedingly apt to do so.

The comments by Mr. Johnson were submitted to Mr. Bush and his reply is given as follows:

"I think that Mr. Johnson must have overlooked some things in my report. In the first place, he states that it is unfortunate that the chemical analyses were not given in full. You will notice, however, by examining a copy of my report, that the full analysis of the gray iron is given.

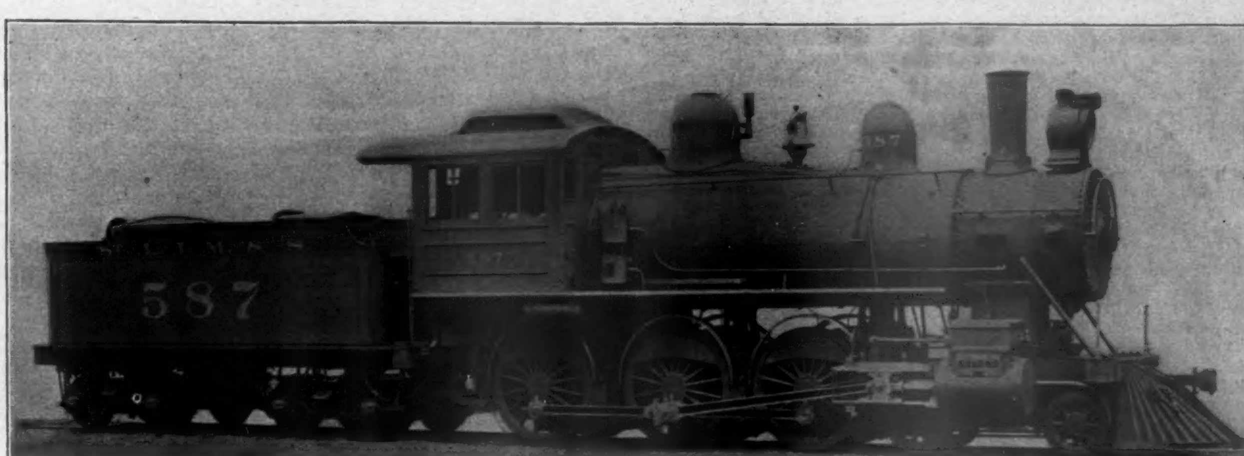
"With one or two exceptions, there is not sufficient difference in the other elements, besides carbon, between the wheels that stood the thermal test and those that did not, to warrant the supposition that these other elements are responsible for a wheel standing the thermal test, or not, as the case may be. The only element in all of the analyses of the gray iron that does vary much is that of the combined carbon, and this element is marked as between those that stood the thermal test and those that did not, and the particular point that my re-

port was intended to bring out was that while there may be a difference in the carbon in the gray iron, yet this difference disappears in the chill, and as a result of this disappearance, it is fair to presume, so far as chemical analysis is concerned, that the wear of the chill will be the same. This point is brought out to controvert the theory advanced by some wheel makers that if wheels are manufactured to stand the thermal test, they must have a smaller quantity of combined carbon, and this being the case the durability of the chill would be impaired. It only remains now for the advocates of such a theory to demonstrate the incorrectness of the conclusions deduced in my report."

TEN-WHEEL FREIGHT LOCOMOTIVES—MISSOURI PACIFIC RAILWAY.

The Rogers Locomotive Company have completed 15 freight locomotives of the single expansion, ten-wheel type for the Missouri Pacific Railway, for use on the St. Louis, Iron Mountain & Southern, one of which is illustrated in the accompanying engraving. The following table gives the principal dimensions:

Fuel	Bituminous coal
Cylinders	20 by 24 inches
Drivers, diameter	60 inches
" material	Cast steel
Driving wheel base	12 feet 6 inches
Total " "	23 feet 4 inches



Rogers Ten-Wheel Locomotive—Missouri Pacific Ry.

Weight on drivers	109,700 pounds
" " truck	36,000 pounds
" total	145,700 pounds
Heating surface, tubes	1,953 square feet
" " firebox	156 square feet
" " total	2,109 square feet
Grate area	28.8 square feet
Tubes, diameter	2 inches
" length	13 feet 5 inches
" number of	278 inches
Grates, length	102 inches
" width	40⅝ inches
Boiler	Extended wagon top
" diameter front end	60 inches
" thickness of barrel	⅝ inch
" " " dome course	21-32 inch
" " " crown	⅝ inch
" " " tube sheet	½ inch
" " " sides	½ inch
Truck wheels	30 inches
Tender, water capacity	4,000 gallons
" frame	10-inch channels
" trucks	Diamond
" " bolster	Cast steel
" wheels, diameter	33 inches
" " kind	Ramapo

The special equipment includes two 3 inch Coales safety valves, No. 9 Nathan triple sight feed lubricators, Westinghouse and American brakes, Janney couplers, Midvale steel tires, Friedman non-lifting injectors by Nathan & Co., and National hollow brake beams.

The Oil City Derrick reports that the total production of Pennsylvania oil for the first nine months of the present year, as shown by the pipe line runs, has been 23,538,185 barrels, or 86,220 barrels a day, as compared with 34,724,684 barrels, or a daily average of 95,136 barrels, in 1897. The daily average this year is, therefore, 8,916 barrels below that of last year.

CONSOLIDATION OF MASTER CAR BUILDERS' AND MASTER MECHANICS' ASSOCIATIONS.

The subject of the consolidation of the Master Car Builders' and Master Mechanics' Associations was discussed at the September meeting of the Northwest Railway Club, and was introduced in a paper by Mr. J. H. Goodyear, Chief Clerk in the Motive Power Department of the Chicago Great Western Railway. Mr. Goodyear argued that the Master Car Builders should not consent to the consolidation, and stated that the good work was formed of officers who were not representative car men that the membership of the M. C. B. Association last year, were good reasons for keeping the organizations separate. The membership was made up as follows: Master Car Builders, 30 per cent.; Assistant Superintendents of Motive Power, 5 per cent.; General Superintendents, 1 per cent.; Superintendents of Motive Power or Master Mechanics, and Foremen, 20 per cent.; Mechanical Superintendents, 20 per cent.; 24 per cent. being represented by men on roads too small to have separate officers at the head of the car department. The general officers were not representative car men, and in this consolidation the Master Car Builders would be lost sight of. Another argument was that there was a tendency to place engine men, car men and roundhouse forces under the charge of the officers of the transportation department, which was not to be desired. These views were answered by Mr. Tracy Lyon, Master Mechanic of the Chicago Great Western, and his statements are so clear and so good that we print them nearly in full, as follows:

I will take issue with the statement that 41 per cent. of the Master Car Builders' Association are locomotive men. The term "locomotive men" is entirely a misnomer. Those called locomotive men take as much interest in and have as much responsibility for the cars as they have for the locomotives; simply because they are Superintendents of Motive Power, Mechanical Superintendents or General Master Mechanics does not make them locomotive men pure and simple. They are responsible to their managers just as much for the cars and for the painting of the cars as they are for the locomotives and their operation.

The consolidation of the Master Mechanics' and Master Car Builders' Associations would seem to be in the direction of centralization and a decrease in the friction of business, and, therefore, it is bound to come. It seems to me that the objections offered to the consolidation of these two associations are more in the form than the substance. Certainly no one has a right to belittle the work done by the Master Car Builders' Association, and I certainly do not wish to do so. It has fulfilled a most valuable function. At the same time it is certainly open to question whether this same amount of work cannot be done in not only a more expeditious manner, but in a better way for the health of the railroads as a whole.

I would call the attention of those who have spoken in disfavor of the consolidation to the fact that the present M. C. B. code of rules governing the interchange of cars as they stand to-day, and their development in the last two years, are almost entirely the results of the efforts of the so-called "locomotive men." The principle of the present code of rules, throwing upon the owners of the cars the responsibility for their running re-

pairs, originated a few years ago with half a dozen such men. We called it first the "Chicago agreement," and operated under this agreement for a year as a matter of trial. The first year that such a change was proposed to the Master Car Builders' Association it failed to carry. The second year it carried after considerable hard work on the part of those who were interested in it. Therefore, it would certainly seem that the so-called locomotive men are not without interest in the principal work of the Car Builders' Association. The interests of the two associations are so closely allied and interwoven that it seems a waste of power to separate them. So far as the representation of the Master Car Builders themselves in a general association representing the rolling stock of the United States and Canada is concerned, there is no reason whatever why the Master Car Builders should not be represented as well as the Superintendents of Motive Power and Master Mechanics, and should not have every opportunity for expressing themselves and taking an active part in the proceedings and deliberations. At the same time I think that there are few Mechanical Superintendents who would be willing to intrust to another, even to their own assistants, in fact, the deciding vote in matters pertaining to the interchange of cars, or any other important question concerning the handling of cars, inasmuch as they are the ones who are directly responsible for the result.

At the same time if the Master Car Builder or General Car Foreman, or whoever represents the car department of a railroad, were to attend these conventions with the head of the mechanical department, the latter would have the advantage of his advice, and the Master Car Builder would have every opportunity, as I have said, to take part in the discussions.

The subject of the interchange of cars should not be considered as an art in itself. To those who are specially interested in it the inspection of cars is almost too likely to be considered as a fine art, while as a matter of fact it is merely a means to an end. We have been trying for several years to simplify the inspection of cars and to reduce the laber involved in it to a minimum, and this special agreement of which I have spoken, and the radical changes in the present code of rules brought about by "locomotive men" have been in that direction.

Mr. Goodyear says that unless active steps are taken in a few years the absolute control of engine, roundhouse and car men will be in the hands of train superintendents. That is something I should be rather glad to see. A railroad is not operated for the privilege of inspecting cars or operating roundhouses. The purpose of a railroad is to move freight and passengers. The other things are simply the tools to this end, and they should be handled as such. I believe that before very long the strictly operating part of a railroad, including the control of engine, roundhouse and car men, will be more entirely in the hands of the superintendent, and that the function of the mechanical man will be more in the way of a consulting engineer. As it is now, he is retained practically by the railroad as an expert, yet he has, as such, too much to do with the actual traffic of the railroad. He might accomplish more if he had more leisure to consider quietly the larger problems of the improvement in cars, motive power, fuel handling and consumption, machinery and everything that pertains to the maintenance and operation in itself of the rolling stock and the shops.

PROTECTION OF BRIDGES FROM SALT WATER DRIPPINGS.

The recent action of the Master Car Builders' Association in recommending methods of protecting bridges from the destructive action of brine drippings from refrigerator cars was recorded in our issue of July of the current volume (pages 220 and 246). The Association of Railway Superintendents of Bridges and Buildings at the recent convention considered the subject from the standpoint of those who maintain the bridges. The following paragraphs from the report of a committee gives their views, which are in accord with those of the Master Car Builders:

"That this dripping is very injurious to metal none will question, except perhaps, the owners of refrigerator cars. Some little interest is being taken in this subject by the officials in charge of track and bridges, but little or none by those in charge of the transportation departments, and while the remedy should be applied to the cars instead of the bridges, there will undoubtedly be opposition to this method by the car owners, who will probably be very slow to provide their cars with the necessary protection unless forced to do so by the railroad companies' united action.

"One refrigerator car will produce probably 200 gallons of brine every 24 hours, which is distributed over the roadbed and bridges as the car passes along or is held on a siding. The damage is greatest when these cars are not in motion and on curves where slow speed is maintained. In order to protect bridges in such places, it would be necessary to completely cover their decks with a waterproof protection, with gutters to carry off the brine. This is rendered necessary because the vents in the present refrigerator cars vary in their positions, thereby making it impossible to construct a simple gutter to catch the flow.

"It has been suggested that attachments be made to all cars in such a manner that the flow of brine will always fall in the center between the rails. This will furnish considerable relief and in places where the flow is excessive, provision could be easily made to catch this flow and conduct it away from mtal work. The attachment to the cars would probably not cost more than $5 each, and would be a compromise between the railroad companies on the one side providing a waterproof decking for the structures mostly damaged, and the owners of the cars on the other side providing reservoirs to hold this dripping until discharged at regular stations."

FAILURES OF AIR BRAKE HOSE.

Air brake hose failures from bursting occur at the rate of from eight to ten cases per day on the Lake Shore & Michigan Southern Railway. These figures are from carefully kept records. The bursting of hose is not always accompanied by wrecks and damage, but it is likely to be, and the quality of hose is clearly an important matter. There is no reason to believe the failures on the Lake Shore from this cause are higher than on other roads, but the records are probably most carefully kept.

The cost of splicing air brake hose by the use of a malleable iron thimble casting and the clamps necessary for making tight joints is 7 cents. This price and the fact that the practice was considered entirely safe and commendable was brought out in a recent discussion before the Western Railway Club. The practice is followed by several roads for their own cars, but not for repairs to foreign cars. It was shown to be necessary to test the hose under about 100 pounds pressure to insure tight joints. Out of a total of 40,293 pieces of hose in use on the Chicago, Milwaukee & St. Paul last year there were 6,323 failures, including all causes. Of these 2,766 were spliced and returned to service, about 15 per cent. of the total number in service failed, and the total number that failed after splicing was 14 per cent. of the total number spliced.

The failures of brake hose on the Chicago, Milwaukee & St. Paul Railway for the year ending June 30, 1898, were reported in the proceedings of the Western Railway Club September, 1898, in the following concise form:

CHICAGO, MILWAUKEE & ST. PAUL RAILWAY CO.
REPORT OF FAILURES OF AIR HOSE FOR FISCAL YEAR ENDING JUNE 30, 1898.

EQUIPPED WITH AIR BRAKES.	
Locomotives....	729
Passenger cars.	771
Freight cars.....	16,782
Total..	18,282

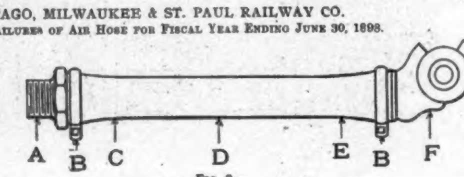


FIG. 2.

DEFECTS FOR WHICH AIR HOSE ARE WITHDRAWN FROM SERVICE.

1 Burst at C.
2 Burst at D.
3 Burst at E.
4 Cracks through rubber at C, exposing canvas.
5 Cracks through rubber at D, exposing canvas.
6 Cracks through rubber at E, exposing canvas.
7 Damage to nipple, A.
8 Damage to coupling, F.
9 Broken clamp bolt, B.
10 Broken clamp bolt, B.
11 Loose fittings.
12 Pulled in two.
13 Crushed.
14 Chafed.
15 Cut.

NOTE.—Defects caused by kinks must be shown in column of figures in prime, thus 1½, 2½, 3½, etc.

MAKER.	KEY. 1	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7	8	9	10	11	12	13	14	15	Total	Returned for Replacement.
	63	91	31	28	34	7	1	3	....	....	..	....	1	13	1	10	1	49	129	15	45	532	
	172	235	58	96	149	30	3	18	8	10	8	....	3	53	3	3	10	196	706	79	219	2059	29
	17	11	2	2	7	....	....	....	....	....	....	....	1	3	....	10	1	14	26	4	15	113	
	58	126	16	25	27	21	3	8	3	2	....	....	....	17	3	....	2	119	599	56	265	1350	24
Spliced hose....	41	10	46	16	39	13	....	1	2	....	1	....	....	2	....	3	..	51	161	1	14	401	....
Miscellaneous.	175	318	93	80	179	26	6	24	12	14	7	1	6	34	4	6	9	196	478	49	151	1868	....
Total..........	526	791	246	247	435	97	13	54	25	26	16	1	11	122	11	32	23	625	2109	204	709	6323	53

Number of hose spliced, 2,766.

GASOLINE AND GAS ENGINES FOR RAILROAD PUMPING STATIONS.

The prevailing method of pumping water into elevated tanks for use of locomotives is to install a steam pump and boiler at or very near the source of supply, and place the outfit in charge of a man who looks after and operates it. The selection of pumps is often neglected, and that of boilers more so, until, as a rule, the pumping equipment is anything but efficient and economical. The necessity for distributing fuel to these plants and the troublesome question of repairs are to be added to the expense of operation, making them rather unsatisfactory, but of late the application of gas and gasoline engines to this service has begun to attract attention. The advantages offered by them are worthy of consideration. While a large proportion of these plants are located in the vicinity of supplies of city gas, many of them are at outlying points along the road, and either gas or gasoline engines may be used to meet all of the conditions. These en-

gines may now be considered as reliable, and they require no more care and no higher order of intelligence in operating than is usually given to the steam plants. The fuel is easily handled, is automatically fed, and there are no ashes. Gas engines require attention in starting, but they may be allowed to regulate themselves afterward, and therefore require much less care than steam apparatus. In some cases the station attendants teach men or give them all the attention they require.

An interesting paper on this subject, read before the Engineers' Society of Western Pennsylvania, contains valuable information and suggestions applicable to railroad water stations. About two years ago an auxiliary pumping station was installed at Pitcairn in connection with the East Pittsburgh Water Works, and a gas engine was decided upon for the following reasons: Gas supply was available from the city mains, this form of engine was always ready for work and did not require banked fires, the cost of putting in a boiler plant and the expense of handling coal and ashes was saved, and, finally, the pump could be automatically controlled. A triplex 8½ by 8 inch single acting pump was selected which was guaranteed to pump 225 gallons per minute against a head of 325 feet with an expenditure of 25 horse power, the engine being guaranteed to give 25 brake horse power for a consumption of 15 cubic feet of gas per horse power per hour. The actual consumption was only 13.42 cubic feet. Records are given of gasoline engines working on a consumption of one-third and four-tenths of a gallon of gasoline per horse power per hour, and the author of the paper shows that the fuel consumption of small engines bears a close relation to the duty when compared with larger units. These examples were selected from several given by the author, and the paper should be read by officers who have pumping plants in charge. One of the strongest recommendations of gasoline and gas engines is that the fuel consumption ceases when the engine stops, they may be started without delay due to banked fires, and one man may attend several of them.

Old ideas as to fine art in painting locomotives and tenders are giving place to practicable and serviceable ones. The "Railroad Gazette" says that the New York, Chicago & St. Louis has found that considerable saving can be made over the present methods of painting and lettering locomotives and tenders. This road now paints the tenders with asphaltum applied with a broad brush, while the letters and numbers, instead of being made on the tenders and locomotives themselves, are painted on wooden sign boards, which are held in place by bolts. In this way all the lettering can be done in the paint shop, while the engine and tender are undergoing repairs, so that the locomotive is not kept out of service several days while being lettered. Mr. Mackenzie, the Superintendent of Motive Power, states that in this way the painting costs between $30 and $35 less for each locomotive than it did formerly.

PERSONALS.

Mr. E. C. Palmer, Secretary and General Manager of the Standard Tool Company, of Cleveland, died Oct. 13.

Mr. James Carmichael, Superintendent of the Machinery Department of the Harlan & Hollingsworth Company, is dead.

Mr. E. D. Jameson has been appointed Assistant Master Mechanic of the Western Division of the Grand Trunk, with office at Battle Creek, Mich.

Mr. F. B. Goodrich has been appointed assistant engineer of the Houston & Texas Central, with headquarters at Houston, Tex.

Mr. F. W. Gilcreast has been appointed Division Engineer of the Mahanoy and Hazleton division of the Lehigh Valley, with office at Hazlton, Pa.

Mr. Henry Pape has been appointed chief engineer of the water lines of the Oregon Railroad and Navigation Company, in place of Mr. Reuben Smith.

Mr. Robert Carritt has been appointed Chief Engineer of the Mississippi Valley Railway, with headquarters at 806 Chestnut street, St. Louis, Mo.

Mr. Alfred Lovell has been appointed Assistant Superintendent of Motive Power of the Northern Pacific. He was formerly Engineer of Tests of the road.

Frank C. Doran, Engineer and General Roadmaster of the Chicago & Western Indiana and the Belt Railway of Chicago, died at his home in Chicago October 15.

Mr. J. W. Patten, Chief Clerk to the Second Vice President of the Erie, has been appointed Assistant Purchasing Agent of that road, with headquarters at New York.

Mr. J. D. Trammell has been appointed Chief Engineer of the International & Great Northern, with headquarters at Palestine, Tex. He was formerly Resident Engineer.

Mr. J. E. Price, district superintendent of the Intercolonial Railway at Truro, N. S., has been appointed general superintendent of that road, with headquarters at Moncton, N. B.

Mr. William H. Clark has been appointed General Manager of the Lowell & Hastings, in addition to his previous duties as Traffic Manager. He has held the last-named position since 1890.

Mr. L. H. Hilton resigned as President and General Manager of the Sylvania Railroad at the annual meeting in Sylvania, Ga., September 29, and M. P. Daffin was chosen president and treasurer.

Mr. C. A. Delaney, formerly Superintendent of the Richmond Locomotive and Machine Works, Richmond, Va., has been appointed Superintendent of the Dickson Locomotive Works, Scranton, Pa.

Mr. Gustave R. Tuska, Chief Engineer of the Panama Railroad Company, has also been appointed Consulting Engineer to the American Representative of the Russian Government in connection with the Chinese Railroad system.

Mr. W. H. Russell, traveling engineer of the Southern Pacific, between Bakersfield, Cal., and El Paso, Texas, has been appointed assistant master mechanic of the road at Oakland, Cal., and Mr. Jesse C. Martin has been made traveling engineer.

Mr. B. S. Snyder, foreman of the roundhouse of the New York, Chicago & St. Louis at Conneaut, O., has been appointed Master Mechanic of the Columbus, Sandusky & Hocking, with headquarters at Columbus, O., vice Mr. T. M. Downing, resigned.

Mr. Joseph A. West, Secretary and General Freight and Passenger Agent of the Sumpter Valley Railway of Oregon, has accepted the position of Chief Engineer of the Utah & Pacific, which is to be built from Milford, Utah, to the Nevada State line, 75 miles.

Mr. Andrew G. Wilson, Superintendent of the machine shop of the Harlan & Hollingsworth Company, Wilmington, Del., has resigned after a service of 36 years to accept a position as manager of the Maryland Steel Company's ship yard at Sparrow's Point, Md.

Mr. J. S. Chambers, formerly Master Mechanic of the Illinois Central at Paducah, Ky., has accepted the position of Superintendent of Motive Power of the West Virginia Central & Pittsburg, with headquarters at Elkins, W. Va., to succeed Mr. J. S. Turner, resigned.

Mr. Paul J. Myler, Secretary of the Westinghouse Manufacturing Company, Ltd., at Hamilton, Canada, will succeed George F. Evans as Manager when Mr. Evans leaves for St.

Petersburg, Russia, to establish a plant for the manufacture of brake apparatus in Russia.

Mr. M. F. Bonzano, whose resignation as Superintendent and Chief Engineer of the Columbus, Sandusky & Hocking has been announced, has become General Manager of the Chattanooga Southern, a position which he held before taking the one from which he now resigns.

Mr. George H. Kimball, formerly Superintendent of the Eastern Division of the New York, Chicago & St. Louis, has been appointed Superintendent and Chief Engineer of the Columbus, Sandusky & Hocking, with headquarters at Columbus, O., to succeed Mr. M. F. Bonzano, resigned.

Col. D. S. Wagstaff, of Detroit, Mich., General Northern Agent for the Cincinnati, Hamilton & Dayton, has been appointed representative of the Detroit White Lead Works and Detroit Varnish Company. Col. Wagstaff was formerly connected with the passenger departments of the New York Central, West Shore and Grand Trunk roads.

Mr. J. J. Donavan, Vice President and General Superintendent of the Bellingham Bay & Eastern, has also been appointed General Superintendent of the Bellingham Bay & British Columbia, with headquarters at New Whatcom, Wash., in place of Mr. C. L. Anderson, who has been General Superintendent, Chief Engineer and Purchasing Agent.

Mr. F. F. Wittekin, formerly Chief Engineer of the Sinnemahoning Valley and afterward Chief Engineer of the Kishacoquillas Valley Railway, has been appointed Consulting Engineer and Technical Director of the Government railroads of Colombia, South America, of which he has been Chief Engineer since February 1, 1896. Headquarters, Medellin.

Mr. John Lundie, M. Am. Soc. C. E., has been appointed Consulting Electrical Engineer of the Brooklyn Elevated Railroad. He has given a great deal of attention to matters connected with the substitution of electricity for steam on railroads and for some time has been retained by the Illinois Central for this work. His New York office is 71 Broadway.

Mr. H. Frazier, late Chief Engineer of the Chesapeake & Ohio, has been appointed Chief Engineer of the railroad to be built from Canton to Hankow, China, by the China Developing Company. Mr. Frazier was Chief Engineer of the Chesapeake & Ohio from July 1, 1891, to June 1 of the present year, when he resigned, and previous to 1891 was Superintendent of the Huntington and Cincinnati divisions of the same road.

Mr. Thomas A. Fraser, Superintendent of the Wells & French Car Shops, shot himself at his home in Chicago on October 13, dying instantly. Illness and consequent despondency was given as the causes leading him to take his life. Mr. Fraser was widely and favorably known through his connection with the Wells & French Company, and also formerly as Master Mechanic of the Minneapolis, St. Paul & Sault Ste. Marie Railway.

A. W. Stedman, formerly for many years chief engineer of the Lehigh Valley Railroad, died at Mauch Chunk, Pa., October 7. He was born at Mauch Chunk in January, 1844, and entered railway service March 4, 1861, as telegraph operator on the Lehigh Valley. Two years later he entered the service of the engineering department of the same road, and worked three years as levelman, when he was appointed assistant engineer. After holding the latter position for 15 years, he was for two years principal assistant engineer, and was appointed chief engineer in 1883. He retired from the last named position in March, 1893, but continued as consulting engineer of the road.

Mr. L. C. Burgess, one of the best known railway supply men, died at his residence, near Chicago, Oct. 3, after an illness of several months. He was born in 1847 at Hancock, N. H., and went to Chicago in 1875 as head of a department of the works of Wheeler & Wilson Sewing Machine Company. He was afterward in the business of manufacturing bolts and a member of the firm of Schumway & Burgess. His connection with the railway business began as a representative of the Ajax Forge Company, and afterward he was connected with the Terre Haute Car & Manufacturing Company, and later was General Manager of the Muskegon Car Company. When the National Hollow Brake Beam Company was organized he returned to Chicago and was given charge of the sale department, and was connected with that concern up to the time of his death. Mr. Burgess had a great many friends, and among the closest of them were those with whom he was associated in business.

Frank F. Hemenway, who was well known as one of the editors of the "American Machinist" for fourteen years and also as the author of an excellent book on the steam engine indicator, died in Brooklyn October 14. He was a thorough mechanic and served as such in a number of manufacturing and railroad shops. He experimented with and assisted in the development of the Richardson pop safety valves and the Richardson balanced slide valve, as well as designing the Hemenway automatic cut-off engine, which, however, was not a permanent success. As a writer he began to contribute to the columns of the "American Machinist" in 1879 and became associate editor in 1881. On the death of Jackson Bailey, in 1887, he became editor and held the position until his resignation in 1894. The "American Machinist" says of him: "His information was wide and marvelously correct, and his judgment more than kept pace with it. The word that came from his pen or his tongue was never misleading. Personally he was a true friend. He was kind and actively helpful to all with whom he was associated. He did good and not evil all his days to all he met in the walks of business."

BOOKS AND PAMPHLETS.

"A Handbook of Engineering Laboratory Practice," by Richard Addison Smart, M. E., Associate Professor of Experimental Engineering, Purdue University. 12mo.; cloth, 290 pp., illustrated. John Wiley & Sons, New York, 1898. Price, $2.50.

This little book is to be commended for the excellent arrangement of subjects presented, and for the concise character of its descriptions. While intended primarily as a manual for the use of students in technical schools, it will prove suggestive to many engineers in active service, and especially useful to those who, from force of circumstances, have failed to keep in touch with modern laboratory methods. Methods and apparatus employed in proving the accuracy of such instruments of observation as are commonly used in engineering work are briefly but accurately described, and the course to be followed in investigating the performance of machinery of many kinds is carefully outlined.

The book contains thirteen chapters, besides an introduction, the heads of which are as follows: "Elementary Measurements, Measurement of Liquids, Measurement of Gases, Measurement of Pressure, Measurement of Temperature, Calorimeters, Measurement of Power, Strength of Materials, Steam Boiler Testing, The Steam Engine Indicator, Steam Engine Testing, Testing of Hydraulic Machinery, Miscellaneous Tests." While much of this work necessarily follows lines previously defined, the book presents ample evidence of combinations of apparatus and of methods not before published. It ends with a very complete index, a feature which is too often entirely omitted or left incomplete in the modern engineering handbook.

A good start has been made by the author in this work, and he should be encouraged to elaborate and enlarge it in future editions. In the interests of railroad men and stockholders as well, the author is urged to tell what he knows about the testing of a locomotive, and we hope this edition will sell so well as to give him the opportunity in the near future.

"The Story of American Coals," by William Jasper Nicolls, M. Am. Soc. C. E.; octavo, 405 pp. J. B. Lippincott, Philadelphia, 1897.

This book is intended for those who wish to know about coal without looking through several books. The arrangement of subjects is logical. It begins with the origin of coal and its development, and follows the various paths whereby it reaches the consumer and tells of the different uses to which it is put. It is a story, told in an interesting way, and is so well indexed that it is also a reference book. It is devoted entirely to American coals, of which $200,000,000 worth are mined annually. The author has prepared himself for his task by fifteen years' work in the Pennsylvania coal regions, much of the information having come from his personal experience. The chief subdivisions of the subject are: Origin, development, transportation and consumption. Theories of origin, the various methods of mining and the transportation problems, together with the study of combustion, the important question for the future of the industry, and a discussion of the uses of coal for steam, gas and coke making, constitute a wide field and it is well covered. The story is admirably written in a very simple, enjoyable style. A great many statistical figures are given and the work is altogether a satisfactory one. Such matters as smoke prevention and the use of the Wegener system for burning powdered coal and the causes of spontaneous combustion are to be found in the book. The author has a proper appreciation of the industrial importance of coal and shows the intimate and inseparable relations betweeen coal supply and railroad and water transportation. The publishers have done their part handsomely. The binding and the paper are good, and the large type and excellent typographical features are praiseworthy.

"La Machine a Vapeur." By Edouard Sauvage, Professor a l'Ecole Nationale Supérieure Des Mines., Baudry & Company, Paris, France. 2 vols.; 468 pp.; 1,036 illustrations.

So much has been written and some of it has been so well written that it would seem unlikely that there was much room for any additional text books or treatises upon the steam engine. At the first sight the book under review presents a very imposing and attractive appearance. The type is large and clear, the presswork has been well done and the paper is of a fair quality, but upon a careful examination of the treatise one is led to the inevitable conclusion that the creation of scientific treatises by compilation is not exclusively confined to this country. The arrangement of the matter in the book is rather curious and leads one to the suspicion that the compilation process has been carried almost to an extreme. For example, the first chapter opens with the description of the essential organs of the steam engine. The opening paragraph says that "fuel burned in a firebox heats water which partially fills a boiler. The heat transforms water into steam which exercises a pressure against the walls of a cylinder." The next sentence states that "most engines have at least one cylinder in which a piston moves, as an essential part." After describing in a desultory way the various parts of a steam engine, including a surface condenser, the old mining engines of the last century, slide valves, the general form of horizontal engines, with numerous illustrations of types of compound and triple expansion engines, in none of which is there a really adequate description, the second chapter opens with physical and mechanical laws. In this the professor appears, and it is scientific in the highest degree if diagrams and equations constitute or insure scientific accuracy. This is followed by a chapter on the work of steam, in which indicators and their functions are extensively described and illustrated, as well as dynamometers, and this in turn is followed by the theoretical cycles of the work of steam and the action of the walls of the cylinder in producing internal condensation. The illustrations throughout are fair, but are not printed with the distinctness which the reader has the right to demand. Many of them bear the evidence of being reproductions from previous engravings, and this is especially true of the wood cuts. It is difficult to understand the system upon which the book has been compiled, for a compilation it most assuredly is. There is no clearly defined method of treatment.

Valves of all sorts and descriptions are illustrated and very briefly described, but it is well within the limits of truth to say that for a man unacquainted with the art it would be impossible to lay out a single one of the many valve motions described, from the information given him in the text.

The book, as has been said, is largely a compilation taken from periodical publications, builders' catalogues and previous works on the steam engine which have, in course of time, found their way to the pigeon holes of the author to be taken out and put together in the compilation before us. Like other compilations of this sort where an attempt has been made to do a great deal within a very small space, the result has been desultory work in many particulars. The book is a treatise on the steam engine, and it handles not only the stationary engine, but the locomotive, marine and traction engine as well.

The most satisfactory portion of the book is that devoted to tubular boilers, not that the text or the suggestions to be derived from it can claim any very great amount of originality, but because the illustrations are very complete and give a clear idea of the various methods of boiler construction that are now in use, and which can be shown by illustrations as well as by the text. As a final illustration of the mixture or lack of order of the book, we will state that in one single chapter we have tubular boilers, boiler construction, bracing, riveting, method of making laps, water tube, marine, locomotive boilers, water testing, injectors and water purifiers, to say nothing of such minor matters as water gauges, stop cocks, safety valves and steam gauges.

The principal value of the book, then, may be said to lie in the large number of illustrations which it contains and the most excellent index which accompanies it. There is not only a complete alphabetical index referring to all parts of engines that are mentioned or treated, but there is a list of authors and their works from which quotations have been made. In addition to this, there is a regular table of contents which is thoroughly well amplified. This part of the work has been most excellently done, and can well serve as an example to any author who contemplates either the compilation or the writing of a new book on scientific subjects.

"Proceedings of the Thirty-second Annual Convention of the Master Car Builders' Association. Held at Saratoga, New York, June, 1898."

The volume before us is uniform with those recently issued by the association, and besides the proceedings contains the usual information, such as a list of members, constitution and drawings of the standards and recommended practices. The larger portion of the book is devoted to the reports of committees and the deliberations and discussions of the convention of the past summer. The large folded plates containing the standards of the association have been improved by captions which may be seen without unfolding the plates. This feature is a commendable one, and the selection of the drawing wanted may be very easily made. The volume has appeared with the usual promptness of the Secretary, Mr. Cloud. He and his assistants deserve credit for handling such a large amount of work so quickly.

"Soft Coal Burning," by C. M. Higginson. Fifth edition. Printed by the Railway Master Mechanic, Chicago, 1898.

This is an 18-page illustrated pamphlet devoted to a study of the proper method for burning soft coal in stationary and locomotive boilers. Mr. Higginson, who is now assistant to the President of the Atchison, Topeka & Santa Fe Railway, has given a great deal of attention to this subject, and has been exceedingly successful in applying the methods he describes. We have watched this pamphlet through its five stages of development, and consider it an excellent treatise, although very brief, and it is hoped that it will continue to grow and gain wide distribution. One of the most important of the points made in it is the necessity for compelling intimate mixture of the products of combustion and oxygen, coupled with provisions for obtaining complete combustion before the flames are extinguished by contact with relatively cool surfaces. The author has the secret of smokeless and efficient combustion. He considers the subject of heating surfaces in locomotives, and suggests the use of corrugated tubes to break up the streams of the products of combustion and thereby increase the evaporative efficiency. The author's ideas have been repeatedly expressed in our columns. He lays no claim to original discovery in the matter of coal-burning, but records the results of methods and experiments covering a long period, the applications of which have been very satisfactory.

"Twelfth Annual Report of the Commissioner of Labor, 1897; Economic Aspects of the Liquor Problem." Government Printing Office, Washington, 1898.

"Professional Papers of the Corps of Royal Engineers," (England). Edited by Captain R. F. Edwards, R. E., 1897. Published by the Royal Engineers' Institute, Chatham, England, 1897; price 10s. 6d.

Catalogue of the Michigan College of Mines, 1898. With Statements Concerning the Institution and Its Courses of Instruction for 1898-1900. Published by the college, Houghton, Michigan, August, 1898.

Bulletin of the University of Wisconsin No. 26, Containing an Address by Mr. Onward Bates, Engineer and Superintendent of Bridges and Buildings, Chicago, Milwaukee & St. Paul Railway.

"The Journal of the Association of Engineeering Societies" for August contains three papers on the abolition of the grade crossings on the main line of the Boston & Albany Railroad in Newton, Mass., by Messrs. Irving T. Farnham, William Parker and W. G. S. Chamberlain, of the Boston Society of Civil Engineers; and one on power consumption on electric railroads, by S. T. Dodd, of the Civil Engineers' Club of Cleveland. In the first series of papers Mr. Farnham deals with the history of the improvement and with the street and drainage work connected with it; Mr. Parker with the depression of the railroad tracks, and Mr. Chamberlain with the bridges over the tracks. All the papers are freely illustrated. Mr. Dodd, in his paper, gives a scholarly analysis of the several items of work performed by the electric current on railroads, and illustrates his paper by diagrams giving speed, torque and acceleration curves.

"History of the Railroad Ticket." This is a 22-page pamphlet by the Rand Avery Supply Company of Boston. The author, Mr. Robert S. Gardiner, with the assistance of colored reproductions of tickets, outlines the great advancement which has been made in the printing of railroad tickets since 1836.

"Coupler Computing Tables."—This is a pamphlet containing a table of information about M. C. B. couplers. It is standard size and gives a list of couplers, the weight of material in each, and the original and scrap values. Its object is to facilitate the work of billing for couplers and their parts. It is compiled and published by Messrs. G. W. Glick and John H. Nichols, of Cleveland, Ohio.

"Electric Street Railway History," Part I., is a 40-page illustrated pamphlet received from the Westinghouse Electric & Manufacturing Company. It contains a review of the development of Westinghouse railway motors with references to generating apparatus and brief remarks on the possibilities of the future. The pamphlet shows why this company has led and now occupies the leading position in electric railway work.

The standards and recommended practice of the Master Car Builder's Association as revised by the last letter ballot, may be had in pamphlet form from Mr. J. W. Cloud, Secretary, 974 The Rookery, Chicago, at 25 cents per copy. The large sheets of drawings, 30 by 38 inches, corrected by the ballot may be had at 25 cents each. The revised air brake and signal instructions, and the rules for loading long materials are also available in pamphlet form.

Magnolia Antifriction Metal and Camelia Bronze are described in a 38-page illustrated pamphlet issued by the Magnolia Metal Company, 74 Cortlandt street, N. Y. This pamphlet contains much that is interesting to those who use bearings and as a source of information in regard to the comparative merits of different "anti-friction" metals it is worthy of careful consideration. The records of tests by the Bureau of Steam Engineering, U. S. Navy Department, are particularly valuable They are given in detail with tables of results.

"The Hawaiian Islands" is the title of a little pamphlet just issued by the passenger department of the Chicago & North Western Railway. The advantages and characteristics of the islands with regard to business opportunities are set forth, and so much interesting information is given as to make it worth while to write for a copy. The last few pages are devoted to showing that the best way to get there is over the Chicago & Northwestern line, as a part of the Chicago, Union Pacific & Northwestern line. The pamphlet is well printed, and is unique and attractive.

The Safety Appliance Co., Ltd., of Boston, has issued an illustrated, standard size 20-page pamphlet for the purpose of giving information in regard to the appliances manufactured and sold by them. The purpose of these is to advance economical operation of cars and locomotives. Among them are the following: The brake equalizer, which raises brake shoes when a car is loaded and permits of adjustment of brake beams; the drawbar adjuster, which is intended to automatically adjust the height of drawbars to keep them within the limit required by law; the locomotive spring suspension, which discards the equalizer and substitutes a series of leaf and spiral springs, the spirals being coupled to the ends of the leaf driving springs; the dead lever take up, which is a brake slack adjuster for passenger and freight cars and tender trucks, the device being non-automatic and is operated by the inspectors as they examine the condition of the trucks in a train. The appliances are patented in the United States, Canada, Great Britain and France. The address of the Safety Appliance Company is the Wentworth Building, Boston, Mass.

The Weir Frog Company has issued a new catalogue, No. 5, which is similar in appearance to the earlier editions, but has 50 additional pages and 72 new engravings. A number of new devices are shown in addition to the usual product of the works. These are improved spring frogs, on pages 63 to 67; new combination crossings, on pages 109 and 127. A new design of three-throw split switch, with reinforced switch points and adjustable rods, is shown on page 157. The derailing safety switches for sidings are found on pages 170 to 175, and a new form of derailing switch for electric roads is illustrated on page 177. This is a very important device for the protection of crossings between steam and electric roads, and it should be brought to the attention of all officers who are concerned with the saefty of these most dangerous of all crossings. A footguard for frogs, switches and guard rails is shown on page 244, and four pages are devoted to railways for industrial works. A complete illustrated description of the electrical interlocking system under the patents of Messrs. F. C. Weir, Jos. Ramsey and others is given on pages 276 and 297. The catalogue closes with tables and data useful in connection with track and switch work.

The Egan Company, Cincinnati, Ohio, have just issued a handsome souvenir. This concern makes a complete line of woodworking machinery. It is handsomely designed and is printed in two colors, red and blue, and being on fine white paper, makes a patriotic combination of colors. This poster shows about one hundred of their latest improved machines, especially adapted to planing mills, carpenter, sash, door and blind work, furniture, chair and bracket factories, car, railway, bridge and agricultural works, buggy, carriage and wagon builders, spoke, wheel and handle factories, colleges, technical schools, state institutions, navy yards, etc., and every user of machinery should have one of these hung up in his office for reference. This company, which is the largest wood-working machinery concern in the world, have had a special corps of expert mechanics and draughtsmen at work for the past year or eighteen months, whose sole duties have been to design machines on advanced principles and improve those already built. The line of machinery they now have to offer is stated to be superior to any other on the market, and they can furnish either single machines or complete equipment for doing any kind of work in wood. A copy of the souvenir will be sent upon application.

EQUIPMENT AND MANUFACTURING NOTES.

Machines for dovetailing lumber for packing cases are reported to be needed in Nantes, Brest, Loriet, and Concarneau in France. Consul Brittain advises Americans to correspond with Mr. Edward Kerr, 3 Rue Gresset, Nantes.

The Johnson hopper bottom and door and the McCord journal box and lid were specified for the new cars for the Delaware & Hudson, which are being built by the Buffalo Car Manufacturing Co. The Johnson hopper door was illustrated in our issue of August, 398, page 276.

The Carnegie Steel Co. is reported to be about to erect a new gun plant on a plot of ground on the Monongahela, near the armor plate mill. Four buildings will be equipped with lathes and other machinery. The addition will require 2,000 more hands.

Messrs. William R. Trigg and J. J. Montague, of the Richmond Locomotive Works, are to establish a shipbuilding company and a permanent plant at Richmond for the construction of present contracts with the Government and for further shipbuilding work. The capital is $300,000,000, and Mr. Trigg is to be manager.

The Chicago Pneumatic Tool Company has found it necessary to open an office in the far West. The President of the Company, Mr. John W. Duntley, has just returned from an extended trip to the Pacific Coast and found so great a demand for the pneumatic tools as to require a branch office, which has been located at 537 Miss.on street, San Francisco, under the charge of Mr. Henry Englas.

The Schoen Pressed Steel Company of Pittsburgh receives so many inquiries concerning steel cars from all parts of the world and there are so many orders in hand as to lead authorities on the subject of iron and steel to predict that this industry will take a very high place among those using steel. The present capacity of the Schoen shops is 150 cars per week, and orders are now on the books to keep them busy for some time.

Boyer pneumatic hammers by the Chicago Pneumatic Tool Company are being used in constructing a new floor system and generally strengthening a 265 ft. span of the Illinois Central bridge at West Point, Kentucky. Compressed air is furnished by a 12 H. P. gasoline engine direct connected to an air compressor and placed on the bridge. The hammers are driving ¾ and ⅞-in. rivets and each does the work of four men by the hand method.

An engine shaft weighing 63,00 pounds, 27 feet 10 inches long, with a maximum diameter of 37 inches, is being made by the Bethlehem Iron Co. for the Corliss Steam Engine Co. The diameter at the bearings is 34 inches, and at the crank dise fit 32 inches. It is hollow, the hole being 17½ inches diameter. The specifications call for an elastic limit of not less than 50,000 pounds per square inch, and an elongation of 18 per cent. in a test bar one inch in diameter and 10 inches long.

Comparisons of the merits of several different metallic trucks are to be made on the Chesapeake & Ohio. The plan is to build 100 coke cars of 30 tons capacity at the shops of the road and equip them with five or six different steel trucks. The cars will all be in the same service and the examination for condition under service will allow sufficient time to bring out the relative values of the designs. It is also understood that the makers will be allowed to furnish the best trucks that they can build.

A new window and car sash lock has been invented and perfected by Mr. J. Wilson Wright, 73 Vesey street, New York. It employs a rotating gear, which engages in a rack at the side of the window. This gear is within the lock, and is held at any desired position by two pawls, which are released by finger levers. The advantages stated are that the window may be held at any desired height, or it may be held closed without danger of being either raised or lowered from the outside, and the window cannot fall when held open.

Mr. George H. Campbell, Terminal Agent of the Baltimore & Ohio Railroad at Baltimore, has, in addition to his present duties, been appointed Inspector of Stations and Terminals over the whole line, reporting to the General Superintendents in their respective territories. Mr. Campbell has long been known for his ability in this direction and the object of the appointment is to secure at each terminal better service in every respect, and is in line with the policy of the Receivers to give to the patrons of the road better and quicker facilities for the handling of freight.

Negotiations have been completed for the consolidation of the Union Switch & Signal Company of Pittsburgh and the National Switch & Signal Company of Easton, Pa., and a meeeting of the stockholders of the Union Switch & Signal Company has been called for Dec. 13 next to ratify the purchase of the capital stock of the National Company. At the same time a vote will be taken on a proopsed issue of gold bonds amounting to $500,000 and bearing 5 per cent. The result of the consolidation will be that the switch and signal business of the country will be controlled in Pittsburgh.

The Baltimore & Ohio Southwestern Railroad has just received from the Baldwin Locomotive Works 10 new freight locomotives, eight simple and two compound, for use on the Ohio division, from Cincinnati to Parkersburg. This portion of the road has some rather heavy grades, and these are the first heavy engines to be used on the line. They are expected to increase the train haul about 40 per cent. The simple locomotives have 21-in. x 28-in. cylinders and the compound 15½ and 26-in. x 28-in. cylinders. The locomotives were built from designs furnished by Mr. J. G. Neuffer, Superintendent of Motive Power.

The Chicago, Burlington & Quincy is having 600 gondola coal cars of 80,000 pounds capacity built in lots of 300 each, by the Wells & French Co. and the Michigan Peninsular Car Co., for delivery before Jan. 1. The inside length is 35 feet 10 inches; the inside width 9 feet 1 inch; the length from top of sides to rail, 7 feet 3⅝ inches; the frame, flooring and sides are of wood, and the body bolsters, the brake beams, brasses and draft rigging are the C., B. & Q. standards. The brake shoes are the "Congdon," the brakes, Westinghouse, and the couplers "Chicago." All the castings are of malleable iron. The trucks have the C., B. & Q. standard drivers and frames, and the light weight of the car is 28,400 pounds.

The Baltimore & Ohio Railroad is experimenting with an 80,000-pound coal car between Cumberland and Baltimore, where the heavy movement of coal will justify an increase in the capacity of the cars. The present cars now in use have 50 per cent. greater capacity than those used three years ago, but with the changes in the line and the relaying of the track with 85-pound steel, and the erection of modern steel bridges, the receivers believe it possible to increase the car capacity to 80,000 pounds. Plans are also being made at the Mount Clare shops for a locomotive to weigh between 225,000 and 230,000 pounds, the cylinders to be 23 by 30 inches, and the rest of the engine in proportion. If this engine is built it will be used on the heavy grades between Cumberland and Grafton.

The method of sheathing passenger cars with sheet copper, devised and patented by Mr. W. P. Appleyard, Master Car Builder of the New York, New Haven & Hartford R. R., is meeting with substantial indorsement from a number of roads. The Fitchburg, Erie and Southern Pacific and the Pullman Company have taken it up and the reports are full of high praise. In the far West the relief which it gives from the effects of alkali dust, that is very destructive to varnish, is a strong recommendation. The appearance of the copper sheathed cars that were exhibited at Saratoga last summer was handsome, and Mr. Appleyard tells us that the coating will not require attention or renewal, and that after the experience of coating the first car it may be applied cheaper than paint and varnish.

The condition of the car building industry, as reflected by the annual report of the Michigan Peninsular Car Company, is good. The statement of earnings for the year ended August 31, 1898, showed a total of $679,877.12. Four dividends, amounting to $300,000, were paid. The sum of $100,000 was paid on the $2,000,000 of first mortgage bonds, leaving surplus earnings for the company's sixth fiscal year at the sum of $270,877.12, the best record, with one exception, in its history. The grand total of earnings is $2,306,063.62; disbursements, dividend and interest account, $1,710,000, and operating expenses, $87,539.42, leaving a balance of $508,524.20; material and surplus on hand, valued at $1,554,289.02; cash, $219,878.44; bills receivable, $429,870.70; amounts due from sundry corporations and firms, $376,175.34; audited vouchers for material not yet due, $679,978.77.

The following Baltimore & Ohio rumors are not substantiated at the headquarters of the company: That the B. & O. is contemplating shortening its main line from West Union, W. Va., to the Ohio River by building a new track down the valley of Middle Island Creek to the Ohio River near Marietta; that the B. & O. is about to invade the territory of the Pennsylvania South Western branch and that a road will be built from some point near Connellsville which will reach the coal deposits between the Youghiogheny River and the Pennsylvania Railroad; that the B. & O. is to build a million-dollar tunnel under Mt. Airy, Md., in order to eliminate a heavy grade. The only foundation for this rumor is the fact that re-

cently there has been some talk as to what could be done toward improving that portion of the line, but no action whatever has been taken.

Mr. M. Cokeley, who is probably known to many of our readers, has been made Superintendent of the works of the C. W. Hunt Co., Staten Island, N. Y., having assumed the duties of that position Oct. 14, after several months' work revising the factory systems. Large concerns are beginning to relieve the office management of the providing for the details in office routine, the installation of systems, methods, etc. This work properly belongs to a specialist, one who, constantly keeping his eyes open for improvement, studying the best literature on the subject and devoting his energy entirely to this work, becomes an expert. Mr. Cokeley has made this special work his profession for some time, being for many years with the General Electric Company and later with other prominent firms. His experience as a practical mechanic has been of great benefit to this line of work, enabling him to detect almost instantly the leaks that invariably exist, and which are so destructive to profits.

The Q & C Co. inform us that they have absorbed the Dustless Roadbed Company, of Philadelphia, and the use of oil for the prevention of dust on railroads will be actively pushed by the purchasers. The sprinkling of roadbeds with oil is operated under the Nichol and Mattern patents. It has already been tried by a number of roads with very satisfactory results. The Pennsylvania, the Long Island and the Boston & Albany roads have each treated 100 miles of their track, and the Boston & Albany has the application for its entire line in contemplation. The New York, Philadelphia & Norfolk reports exceedingly satisfactory results, and applications for short distances of about 10 miles have been made on the Fitchburg, New York, New Haven & Hartford, and Chicago & West Michigan railroads. We believe that the latter road has more than this. The Wisconsin Central is now trying it, and a number of other lines have signified their intention of doing so. On the roads first mentioned it is found that three applications the first year are sufficient, and after that it is required less often.

The divisions of the Baltimore & Ohio Railroad west of the Ohio River are to receive the same sort of improvements that have been made on the lines east of the Ohio. Not only are the grades to be reduced wherever it is practicable, but very much heavier motive power is to be introduced. In order to carry the additional weight the bridges on all the divisions are being replaced with heavier structures and the track relaid with heavier rail. It has been demonstrated by actual experiment that these changes will result in an increase in train loading in some places of more than 50 per cent., the average being about 42 per cent. It is the hope of the receivers that within the next two years the Baltimore & Ohio Railroad will be an 18-foot grade road from Chicago to Baltimore with the exception of that portion of it which passes over the mountains, where helping engines must be used. Many of the estimates for the different portions of the work have been made, and those who have seen the plans state that the work can be done at a surprisingly low cost considering the return. It is understood that the policy of rehabilitation adopted by the receivers two years ago will be continued by the new company after the reorganization.

In a recent letter to the Westinghouse Electric and Manufacturing Company, Mr. R. G. Vance, Jr., Superintendent of the Stevens Coal Company, makes the following statements regarding the Baldwin-Westinghouse electric mine locomotive in operation in their mines, and illustrated on page 263 of our August, 1898, issue: "It gives us pleasure to say that this motor is giving the very highest possible satisfaction, and is attracting considerable attention in this valley. It has been running since May 1 and has not cost a dollar in the shape of repairs, excepting a new valve for the sand box and a headlight base broken in a collision with a car. It is running on a road of 25-pound steel rail, 4,000 feet long, over undulating grades varying from 1 to 6 feet per 100 feet. Its regular load now consists of 20 cars of 1½ tons' capacity, and the time required for each round trip is from 17 to 19 minutes. We have pulled as many as 25 of these cars at one trip, which is done with ease. When necessity requires we can pull 30 cars, giving 50 per cent. more capacity than you guaranteed." This is evidence of the qualities of this mining locomotive, which is characteristic of the work done by the Baldwin and Westinghouse companies.

OUR DIRECTORY

OF OFFICIAL CHANGES IN OCTOBER.

Columbus, Sandusky & Hocking.—Mr. George H. Kimball has been appointed Superintendent and Chief Engineer, with headquarters at Columbus, Ohio, to succeed Mr. M. F. Bonzano, resigned. Mr. Kimball was formerly Superintendent of the Eastern Division of the New York, Chicago & St. Louis. Mr. B. S. Snyder has been appointed Master Mechanic, with headquarters at Columbus, Ohio, in place of Mr. T. M. Downing, resigned.

Chattanooga Southern.—Mr. M. F. Bonzano has been appointed General Manager, a position which he held before going to the Columbus, Sandusky & Hocking. He succeeds Mr. M. S. Hoskins.

Detroit & Lima Northern.—Mr. Jules S. Bache, New York, and Mr. James B. Townsend, Lima, O., have been appointed Receivers of this road. Mr. C. H. Roser, Chief Engineer, has also been appointed Purchasing Agent, vice Mr. C. W. Taylor.

Erie.—Mr. J. W. Patten has been appointed Assistant Purchasing Agent, with headquarters at New York.

Houston & Texas Central.—Mr. F. B. Goodrich has been appointed Assistant Engineer, with headquarters at Houston, Tex.

International & Great Northern.—Mr. J. D. Trammell has been appointed Chief Engineer, with headquarters at Palestine, Tex. He was formerly Resident Engineer.

Kelly's Creek.—Mr. J. W. Dawson has retired from the office of Superintendent of the Kanawha & Michigan Railway to accept the position of General Manager of the Kelly's Creek Railroad, with office at Mammoth, W. Va.

Lowell & Hastings.—Mr. Wm. H. Clark has been appointed General Manager, in addition to his duties as Traffic Manager. His headquarters will be at Lowell, Mich.

Lehigh Valley.—Mr. F. W. Gilcreast has been appointed Division Engineer of the Mahanoy & Hazleton Division of this road, with office at Hazleton, Pa.

Mississippi Valley.—Mr. Robt. Carritt has been appointed Chief Engineer, with headquarters at St. Louis, Mo.

Northern Pacific.—Mr. Alfred Lovell has been appointed Assistant Superintendent of Motive Power, with office at St. Paul, Minn.

Norfolk, Virginia Beach & Southern.—Mr. W. T. McCullough has been appointed General Manager, with headquarters at Norfolk, Va.

Pittsburg, Cincinnati, Chicago & St. Louis.—Mr. Robert C. Bernard has been promoted to the position of Engineer Maintenance of Way.

St. Louis, Iowa & Northern.—Mr. C. J. DuBois has been appointed Chief Engineer and Superintendent, with headquarters at Macon, Ga.

Sylvania.—Mr. L. H. Hilton, President and General Manager, and Mr. G. M. Hill, Treasurer, with headquarters at Sylvania, Ga., have resigned. Mr. P. D. Daffin has been elected President and Treasurer, with headquarters at Savannah, Ga.

Tennessee Northern.—Mr. A. A. Glasier has been elected President, succeeding Mr. H. M. La Follette, who has been elected Vice-President. Mr. Glasier's headquarters are at Boston, Mass.

Utah & Pacific.—Mr. Jos. A. West has been appointed Chief Engineer. He was formerly General Freight and Passenger Agent of the Sumpter Valley Railway of Oregon.

Western Maryland.—Mr. H. E. Passmore has been appointed Master Mechanic, with headquarters at Hagerstown, Md. Mr. David Holtz has been heretofore Master Mechanic, with headquarters at Union Bridge. Mr. Passmore has been Foreman of the Philadelphia & Reading shops at Tamaqua.

West Virginia, Central & Pittsburgh.—Mr. J. S. Chambers has accepted the position of Superintendent of Motive Power, with headquarters at Elkins, W. Va., to succeed Mr. J. S. Turner, resigned.